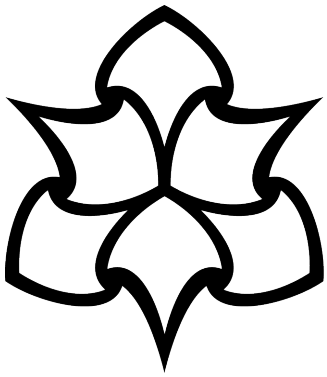

IASDR 2019

DESIGN REVOLUTIONS

IASDR 2019 CONFERENCE PROCEEDINGS | **VOLUME 1**

CHANGE | VOICES | OPEN

EDITORS Professor Martyn Evans, Dr Annie Shaw, Dr Jea Hoo Na

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MANCHESTER SCHOOL OF ART

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The International Association of Societies of Design Research (IASDR) is an international, nongovernmental, non-profit-making, charitable organisation, and is comprised of member societies of design research from around the world. Established on 01 November 2005, its purpose is to promote research or study into or about the activity of design in all its many fields of application, through encouraging collaboration on an international level between independent societies of design research. IASDR members include the Chinese Institute of Design (CID), the Design Research Society (DRS), the Design Society (DS), the Japanese Society for the Science of Design (JSSD) and the Korean Society for Design Science (KSDS).

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Design Revolutions explored how design drives and responds to revolutionary thinking through questioning the norm, probing the now and embracing the new. For the first time IASDR conference was held in the UK and fostered new thinking towards a compelling, meaningful and radical dialogue regarding the role that design plays in addressing societal and organisational issues.

The biannual conference enables academics, practitioners and students join together to explore contemporary agendas, emerging directions and future challenges that are at the forefront of design research. IASDR 2019 will provide opportunities for the presentation and publication of a collection of high-quality peer reviewed research papers alongside the space to discuss and debate the evolution and revolution of design.

Editorial

In September 2019 Manchester School of Art at Manchester Metropolitan University was honoured to host the bi-annual conference of the International Association of Societies of Design Research (IASDR) under the unifying theme of DESIGN REVOLUTIONS. This was the first time the conference had been held in the UK. Through key research themes across nine conference tracks – Change, Learning, Living, Making, People, Technology, Thinking, Value and Voices – the conference opened up compelling, meaningful and radical dialogue of the role of design in addressing societal and organisational challenges. The conference was a truly international gathering of the key thinkers in design research from 28 countries. 215 papers were presented and 13 workshops delivered alongside two exhibitions. RADICAL RESPONSES was a peer-reviewed exhibition of the research-informed design practice from academic design staffs from Manchester School of Art. This was complemented by an engaging display of design artefacts from the MATERIAL AND PROCESS INNOVATION COLLECTION curated by University's Special Collections. Such diversity enriched the exchange of ideas at presentations, workshops and social events for the duration of the innovative and dynamic event.

Support and contributions from the design research community have made this conference possible. Our thanks go to each one of our 488 authors for the papers and workshops that provided a rich source of inspiration, all 162 reviewers for ensuring quality and rigour and the 44 session chairs for ensuring the effective flow of ideas and discussion throughout the sessions. We also extend our sincere gratitude to all delegates of the conference who questioned the norm, probed the now and embraced the new. We hope you enjoyed your experience of Manchester and look forward to welcoming you to our city once again.

IASDR 2019 was a part of the design revolution in progress. We are excited to see how these proceedings fuel on-going discourse and debate at IASDR 2021 and beyond.

Martyn Evans, Annie Shaw and Jea Hoo Na

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CHANGE

DESIGN CONTINUALLY EVOLVES AS IT RESPONDS TO THE CONTEXT IN WHICH IT OPERATES. IT SPANS BOUNDARIES AND IS SHAPED BY DISRUPTIONS – BE THEY POLITICAL, IDEOLOGICAL OR CONCEPTUAL. WHAT FORMS OF CHANGE SHOULD DESIGN EMBRACE AND WHO ARE THE THOUGHT LEADERS THAT ARE INSTIGATING CHANGE? WHAT NEW BUSINESS MODELS AND MODES OF OPERATION SHOULD DESIGN SUPPORT? HOW SHOULD DESIGN TRANSITION FROM THE NOW TO THE NEW?

Adapting Service Design Thinking to Local Festivals

Kim, Juhee[a]; Woo, Eunji[a]; Wu, Hoi San[b]; Nam, Ki-Young*[a]

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Successful festivals can have many local benefits. However, most of the time this is not the case. A lot of local festivals are unpopular and a waste of tax money. To shift the focus of festivals from the organisers' needs and purposes to considering all users and stakeholders, service design thinking might provide useful opportunities. Through a literature review and deductive content analysis, three service design methods were proposed as guidelines for improved local festival planning: 1) deep understanding of target groups in the early planning stage, 2) building mutual trust with local stakeholders, 3) establishing stories of the region, and 4) utilising prototyping tools.

Keywords: Local festival, Service design thinking, Event management

1 Introduction

Local festivals are often utilised as tools for supporting local economies and communities. The success of local festivals can bring economic, social, and promotional benefits (Derrett, 2003; Okech, 2011; Shin, 2004). However, planning successful local festivals is not easy.

Many local festivals are criticized for indistinct themes and wasting taxpayers' money; examples of failed cases can be found across the world. For example, Korean municipalities conducted local festivals to encourage the local economy, spending 1,545 billion Korean Won (approximately $1.3 billion) in the last five years in Korea (Kang, 2017). However, many festivals were unpopular and have been criticised for, again, wasting taxpayers' money. According to Carlsen, *et al* (2010), local festivals in Sweden lack unique selling points for differentiation and competitive advantage.

Viability, effectiveness, and long-term sustainability of festivals have become big challenges in event management (Andersson & Getz, 2008). Accordingly, the event management field including local festival planning, explores other values to improve the problems with local festivals. Traditionally, organisers' purposes, budgets, and market situations are considered the main drives for the event management process (Chungbookilbo, 2018; Kim, 2011; Dowson & Bassett, 2015). Recently, however, event management has realized that the participants' experiences and stakeholders' relationships are important factors for planning successful festivals (Pope, Isely & Agbetunsin, 2017; Axelsen & Swan, 2010; Andersson & Gertz, 2008). The new perspectives are very similar to those pursued by service design,

providing opportunities to utilize the knowledge of service design in the event management area.

Service design is a discipline that focuses highly on users' needs and stakeholders' relationships. Services are invisible, intangible products, making user-centeredness and co-creativeness important considerations in the design process. Since the principles of service design and event management share these important aspects, comparing the two fields can give valuable insights into making event management more user- and stakeholder-oriented. Some scholars who have seen the opportunity for service design in the event management field have attempted to apply some methods of service design to event management (Stickdorn & Zehrer, 2009; Zehrer, 2009; Moscardo 2017). However, the values of service design focusing on local festival planning in particular have been little investigated.

Therefore, this research focuses on identifying the service design requirements for proposing a more people-centred planning method for local festivals. Three research aims were formulated: 1) to identify the requirements shared by service design and event management, 2) to compare and contrast of micro-level requirements in local service design and local festival planning, and 3) to discover opportunities to adapt service design to local festival planning.

To accomplish the aims presented above, a literature review and deductive content analysis were conducted. Firstly, the requirements shared by service design and event management were identified from literature to be used as a priory coding scheme. Subsequently, micro-level requirements within each priori codes were coded by open-coding. Finally, each requirement between local service design and local festival planning were compared and contrasted. Based on these, the study provides opportunities to adopt service design thinking in local festival planning.

2 Literature review

A local festival is an event intended to boost the local economy and create an image of the region (Felsenstein & Fleischer, 2003). The goal of local festivals is to vitalize the local region; festivals are usually conducted by local governments or organizations. The process of planning a local festival includes cooperating with heterogeneous stakeholders such as residents, local businesses, technical experts, and government (Woo, Kim & Nam 2019).

Academically, local festival planning belongs in the field of event management in tourism and hospitality, having characteristics of event management in the tourism field and a singularity in dealing with specific local issues. To understand local festival planning at a macro level, a literature review was conducted on local festival planning and event management. Also, a research gap was investigated through previous studies that have attempted to utilise service design concepts for local festival planning or event management.

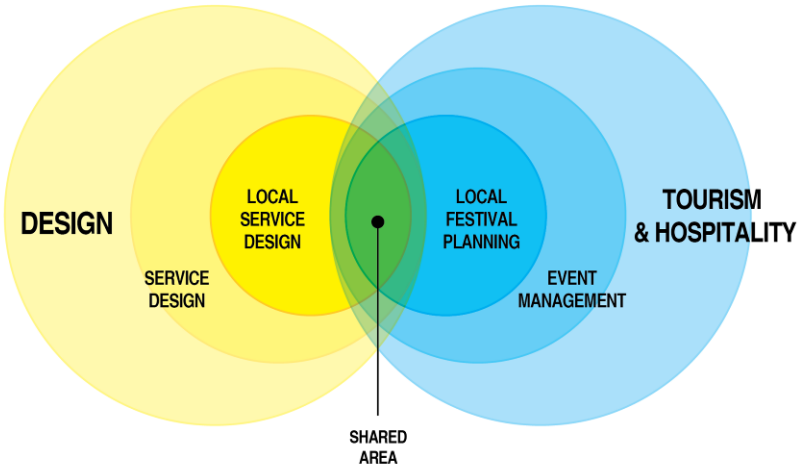


Figure 1. A conceptual diagram of local festival planning and local service

2.1 Local festival planning as service design

Service design is a tool to innovate or improve existing services and make them more desirable and usable, encouraging simultaneous effectiveness and efficiency. Researchers define service design as “a practice that generally results in the design of systems and process aimed at providing a holistic service to the user” (The Copenhagen Institute of interaction design, 2008) and “design thinking as applying methodologies and approaches of design to a broader set of issues and problems in business and society” (Tim Brown, 2008).

Event management deals with different aspects of events, such as economic benefits, social impacts, attendees’ motivation, attendees’ satisfaction, and so on (Getz & Page, 2016; Dowson & Bassett, 2015). Since event management has recently shifted to dealing with people-centred, social, and economic issues for planning more successful local festivals, the holistic approach of service design might be useful to event management.

As mentioned in the Introduction, the importance of people’s experience is the rising issue in the event management area. Traditionally, the most important part of event management was economic benefit. However, this perspective has changed. Getz (2008) and Backman (2017), scholars of the event management field, stress the importance of experience in events. Experiences are becoming more important in evaluating participant satisfaction or the success of events or services. Since service design means carefully considering a user’s experience, service design tools can be effectively utilised in the event management field.

Among diverse events, local festivals have special value to local economies. Local festivals can foster growth for local businesses and communities and encourage residents to continue to live in the city by promoting local patriotism, which can be advantageous to local businesses and reshape the image of a city (Okech, 2011). Therefore, considering local people’s needs and relationships is necessary to lead local development the right way. Service design also has social value pertaining to local issues; service design tools can be effectively utilised in local community development and government activities. For example, IDEO, a design consulting firm, helps local people in need by making practical products that utilise service design tools (Chou, 2018). This case shows that service design tools can be used to collect and effectively reflect residents’ needs.

Likewise, an opportunity for service design applied to local festival planning is observed. Service design can deal with diverse problems and issues and provides effective tools and methods to contribute to society. However, research about how service design can help meet the objectives of local festivals is not conducted enough. Therefore, to get a holistic understanding of service design values for local festival planning, cases in both service design and event management are analysed.

2.2 Shared requirements for event management and service design

Event management and service design share some requirements for the creation of a successful event or service. The following four requirements revealed by the literature review were used as the priori coding scheme in the deductive content analysis.

2.2.1 Understanding the target group

The first requirement shared by both domains is understanding the target group. Both service design and event management consider target groups and have developed tools for understanding them. Service design targets users who are likely to use the services, and event management targets attendees who are likely to visit events. The event management perspective requires understanding the attendees' demographics and motivations for attending festivals and/or making repeated visits (Dowson, 2010; Shanka, 2004). Likewise, service design is inherently user-centred, developing services by meeting users' needs. It is emphasised that services should be experienced through the users' eyes (Stickdorn & Schneider, 2011). Therefore, service design requirements focus on a genuine understanding of users so that designers can understand the users' current problems and how to solve them (Stickdorn & Schneider, 2011).

2.2.2 Considering relationships between stakeholders

The second requirement shared by both domains is considering relationships between stakeholders. Both service design and event management encourage understanding and considering relationships between stakeholders. In event management, stakeholder management leads to the success of events, as higher involvement of stakeholders in planning leads to competitive events (Reid, 2011). Hence, event managers should understand and meet the needs of stakeholders to induce their involvement and cooperation. In service design, stakeholder mapping is mainly used to identify the key stakeholders and their relationships. It is used to discover positive stakeholders to involve in the design process and the risks associated with negative stakeholders (Curedale, 2018). Thus, both service design and event management consider their stakeholders to discover positive resources or potential risks in the planning phase.

2.2.3 Creating experiences

The third requirement found in both service design and event management is creating experiences for people. Experience is a service process consisting of certain touchpoints (Stickdorn, 2009; Lane, 2007). Event management literature stresses the importance of experiences in planning events. For example, Geus, Richards, and Toepoel (2016) mentioned that unique, memorable experiences can be the competitive advantage of events. Likewise, unique experiences can be a powerful selling point in service design. In order to satisfy user expectations, service design encompasses many tools for understanding users and defining service touchpoints of users (Stickdorn, 2009). To sum up, both service design and event management perspectives focus on developing experiences created by services or events for competitiveness.

2.2.4 Receiving feedback for an iterative process

The last requirement found in both areas is receiving feedback for an iterative process. Services and events are not one-off occurrences; both are repeatedly used or held, so the designers and planners can collect feedback to improve the next time. According to Stickdorn and Zehrer (2009), the competitiveness of services ultimately depends on the user's satisfaction, which is determined by the user's assessment. In many event management studies, questionnaires are used to discover attendees' motivations for attending events (Dodd, Yuan, Adams & Kolyesnikova, 2005; Shanka & Tayler, 2004; Li & Petrick, 2005). In that regard, a commonality between the two areas is that they both assess the satisfaction of people and use this assessment for the next event or service.

3 Deductive content analysis

In this study, deductive content analysis was used to analyse data. Deductive content analysis (Hsieh & Shannon, 2005) is used to validate or conceptually extend a theoretical framework or theory; for this study, it was used to find differences and commonalities between service design and event management for local regions based on reviewing related literature. The analysis was conducted by three experienced design researchers with different backgrounds in user experience design and service design. Content analysis was carried out in three steps: 1) defining priori codes, 2) extraction from cases based on the priori coding scheme, and 3) grouping and comparing. This research model is illustrated in Figure 2.

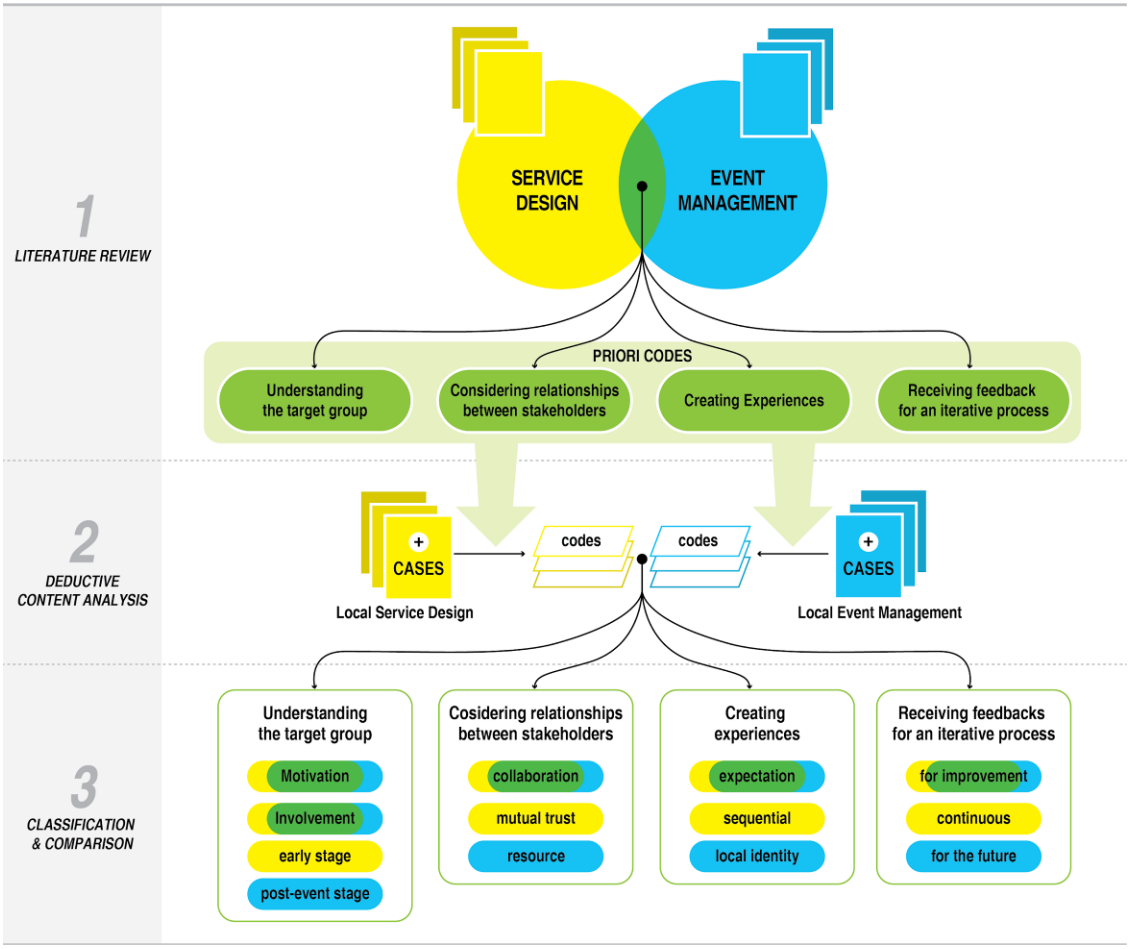


Figure 2. The research model of deductive content analysis

3.1 Step 1. Defining priori codes

Literature on the basic principles of service design and event management was reviewed to define essential requirements in creating successful services and events. For service design, four academic papers and two books indexed as SSCI (Social Science Citation Index) or cited more than 100 times were reviewed. The journals and books cited more than 600 times were considered major theories. For event management in tourism and hospitality, four academic papers and one book that had been indexed as SSCI or cited more than 100 times were reviewed. The principles introduced in the journals and books that had been cited more than 1900 times were considered leading theories.

Based on the open coding, a total of 46 codes were extracted: 19 in service design and 27 in event management of tourism. A commonality in the literature of the two areas emerged; for example, Stickdorn & Schneider (2011) introduced the importance of understanding customers and stakeholders in the principles of service design thinking, and event management in tourism and hospitality has similar ideas. Getz (2008) said that “experiences should be conceptualised and studied in terms of three interrelated dimensions: what people are doing, or behaviour, their emotions, moods, or attitudes, and cognition.”

As a result, four requirements shared by service design and event management were deducted: 1) understanding the target group, 2) considering the relationships between stakeholders, 3) creating experiences, and 4) receiving feedback for an iterative process. The first three requirements belong to the preparation phase for the event or service and the last requirement falls within the post-event or service phase. The requirements are used as priori codes.

3.2 Step 2. Extraction from cases based on the priori coding scheme

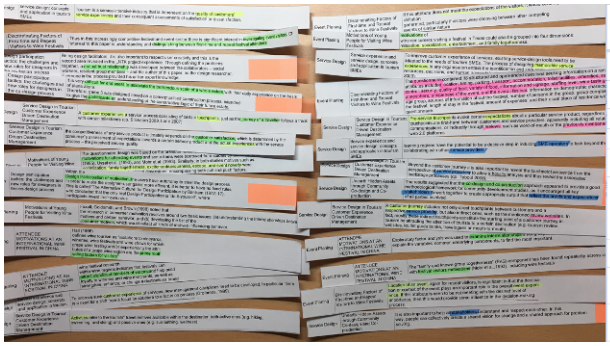
To define the sub-codes, more research papers dealing with actual local festival planning cases were collected. For service design, seven cases related to the local region, local economy, and tourism were selected. For local festival planning, 23 cases about local festivals were selected. The reason the actual cases were considered was to define how the conceptual theories were applied in practical fields. While the service design area is theoretically well-developed, local festival planning is more focused on empirical studies. Therefore, more cases of local festival planning were collected.

The service design cases considered how service design can provide beneficial effects in the local economy and tourism; for example, developing a critical perspective on design-led urban regeneration (Bell & Jayne, 2003), how co-design and co-production could support community development (Lam, Zamenopoulos, Kelemen & Hoo, 2017), and managing service touchpoints to increase users’ satisfaction in tourism (Stickdorn & Zehrer, 2009).

The local festival planning cases mainly focused on encouraging people to visit local festivals and managing stakeholders. Researchers investigated festivals that had established attendees’ motivation and factors that attract attendees’ interest in attending future events as well as festivals (Shanka & Taylor, 2004), that functioned as sustainable attractions while fulfilling their social and cultural roles at the community level and maintaining political and tangible support from key stakeholders (Andersson & Gertz, 2008).

The literature collected in step 1 was also reviewed to search for codes and tools belonging to each area. The codes and tools from the literature were extracted based on the priori codes found in step 1. Subsequently, 83 codes in service design and 125 codes in local

festival planning were extracted to define sub-codes. The deductive content analysis for priori codes and sub-codes is illustrated in Figure 3.



Domain	No.	Corpus (requriements, tools and method)	Priori coding scheme			
			understanding people	relationship of stakeholders	Unique experience	receiving feedbacks
			48	24	23	15
EP	EP04	Hall (1996) defines wine tourism as "visitations to vineyards, wineries, wine festivals and wine shows for which grape wine tasting and/or experiencing the attributes of a grape wine region are the prime motivating factors for visitors"			V	
EP	EP05	wine festival research within wine regions indicates that festivals can attract significant numbers of visitors and help build loyalty to wineries and wine merchants, as well as strengthen, enhance, or change a destinations brand			V	
EP	EP06	The "family and known group togetherness" (FKG) component has been found repeatedly across various studies dealing with festival visitors motivations (Mohr et al.,1993), including wine festivals	V		V	
EP	EP07	Exploratory factor analysis was used to examine interrelationships among dependent variables and explain the variables' common underlying components, to find the most important.		V		
EP	EP08	Thus in this increasingly competitive festival and event sector there is significant interest in investigating event visitors. Of interest to this paper is understanding and distinguishing between first-time and repeat festival attendees	V			V
EP	EP09	The questionnaire contained 18 structured and open-ended questions seeking information on a range of issues. These attributes included location, timing, parking, transport, accommodation, toilet facilities, amenities, service quality, crowd control, security, quality of food, variety of food, information and signage, staffing level, wine tasting, variety of attractions, atmosphere, uniquenss of the event, and the overall festival. Information on demographic characteristics such as gender, age group, sources of information about the festival, number of persons in the group, group composition, mode of travel to the festival, length of stay in the festival, amount of expenses, and their usual place of residence were also included in the questionnaire.	V			V
EP	EP10	if this attribute does not meet the expectations of the visitors, it would certainly have an effect on the level of repeat visitation generated, particularly if visitors were choosing between other competing events of similar nature.	V			V
EP	EP11	Location of an event, again for repeat visitors, is significant in that the destination or context of the event plays an important role in the overall event experience. If this attribute is seen to be not meeting with the desired level of importance, then this would provide some influence in the decision-making process. 이벤트가 갖지는 장소는 반복적인 이벤트 경험의 중요한 영향을 미친다.			V	
EP	EP12	stakeholder roles in tourism planning and development; or collaboration in marketing alliances Resource dependency perspective 이해관계자의 역할, 반환, 한국 중요함 -> 리소스베인 측면에서		V		

Figure 3. Sub-code extraction from cases based on priori coding scheme

3.3 Step 3. Grouping and comparing

The purpose of the third step was to reconstruct the contents of the requirements to enable comparison. This grouping was conducted using the affinity diagram method proposed by Beyer and Holtzblatt (1999). The extracted codes were grouped in both areas based on their functions and objectives; the defined domains showed opportunities for what service design aspects could be implemented within local festival planning. Some strengths were found in codes and tools that only the service design area possessed. As a result, nine sub-codes each were extracted from service design and local festival planning. The sub-requirements and tools in both domains were compared to define commonalities and differentiates. Based on this, possible opportunities were extracted.

4 Content analysis results

As introduced above, four requirements are needed to achieve success in service design and event management: 1) understanding the target group, 2) considering relationships between stakeholders, 3) creating experiences, and 4) receiving feedback for an iterative process. The four requirements were used as priori-codes to extract codes from the collected cases. By analysing the extracted codes, a total of 9 sub-codes in local service design and 9 sub-codes in local festival planning were found. The results of the contents analysis are illustrated in Figure 4.

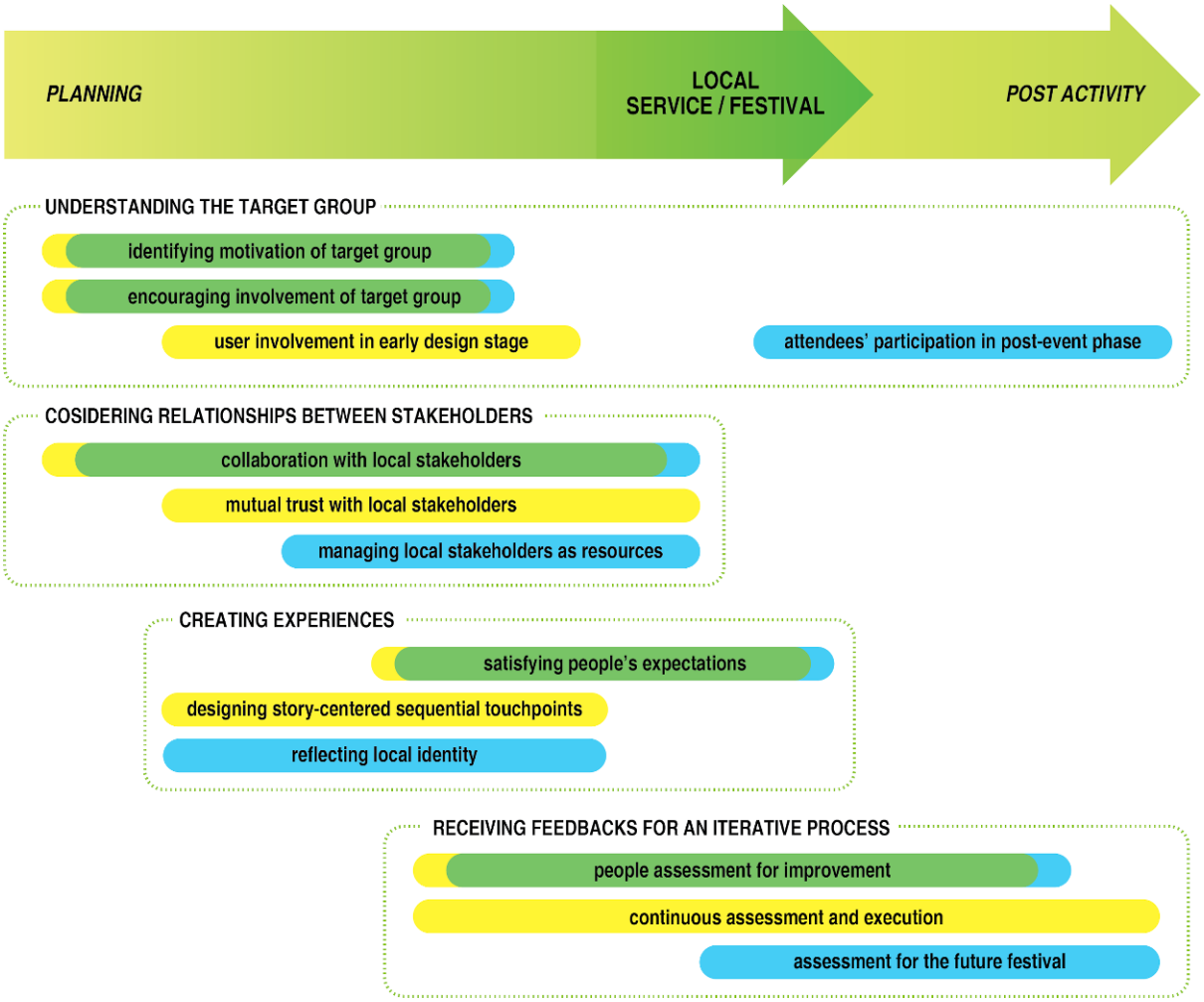


Figure 4. The sub-codes placed in the phase of local service & festival

4.1 Understanding the target group

Understanding the target group is the first shared requirement for service design and event management. In terms of this requirement, two commonalities and two contrasting characteristics were identified in local service design and local festival planning.

First, identifying motivation of the target group is a common sub-code in both local service design and local festival planning. Investigating attendees' interest is particularly meaningful in the competitive local festival area. The motivations of attendees are mostly about fulfilling expected experiences at a particular event; for instance, relaxation, socialisation, entertainment, and family togetherness (Dodd *et al.*, 2006). The user's satisfaction (created by the user's assessment of expectations in certain services) can help to establish the competitiveness of service. Since local festivals are held in various regions, identifying attendees' motivations to travel to different regions is crucial.

Another common sub-code is encouraging involvement of the target group. As mentioned, involving users or attendees is an essential activity to understand their motivation. However, there is a difference in the shared sub-code of the two domains. User involvement in the early design stage is a sub-code discovered in local service design that focuses on understanding users' needs in the pre-service phase (development of a service). Design

activities with local people are commonly conducted to understand specific local issues. This activity means defining and applying the local users' expectations before they experience the local service, and a user-participatory design is commonly used as a method. The co-design approach was perceived as empowering because it helps to identify a number of important insights that non-locals do not know.

Attendees' participation in post-event phase is a sub-code discovered in local festival planning. Local festival planning generally concentrates on activities in the post-event phase to understand attendees' motivations; post-event surveys are the easiest, most common method for this activity. The questionnaire includes items addressing people's motivations for attending events and whether the event attributes satisfied attendees' expectations. It implies that attendees' assessments of events are significant in local festival planning activities, as these evaluations are a good way of showing others (e.g. clients, sponsors, and partners) that the local festival was a success, which can ultimately help to justify future events (Dowson & Bassett, 2015). Consequently, the phases and objective of understanding target audiences are different.

4.2 Considering the relationships between stakeholders

Considering the relationships between stakeholders is the second shared requirement for service design and event management. In terms of this requirement, one commonality and two contrasting characteristics were identified in local service design and local festival planning.

Collaboration with local stakeholders is a common sub-code in local service design and local festival planning. Both local festival planning and service design require a broader stakeholder management perspective. Collaboration is an effective method for community development, as it encourages all key stakeholders to work together to create appropriate output that reflects their needs and expectations and prevents conflicts of interest. Thus, the role of festival organisers or service designers is crucial in developing a supportive network and managing stakeholders' relationships to build the legitimacy of a local festival or service and fulfil multiple stakeholder perspectives.

Mutual trust with local stakeholders is a sub-code discovered in local service design. Service design requires consideration of diverse stakeholders in creating a shared vision for change or a shared approach for problem-solving. It is important to help all local stakeholders understand and respect each other; this allows them to create a shared vision and a shared approach for problem-solving in a region. Defining problems together allows a mutual trust to develop between them. Local service design initiates the management of stakeholders by building empathy between stakeholders and organisers.

Managing local stakeholders as resources is a sub-code discovered in local festival planning. Local festival planning additionally considers stakeholders from the perspective of resource management. Some festivals exhibited extensive cooperation with a wide selection of local agents or stakeholders, but the range of difficulties of this cooperation building and relationship management were clear. To moderate the circumstances, an event organizer can become a decision-maker and a conductor. In other words, local festival planning occasionally uses top-down approaches to manage resources efficiently.

4.3 Creating experiences

Creating experiences is the third shared requirement for service design and event management. In terms of this requirement, one commonality and two contrasting characteristics were identified in local service design and local festival planning.

Satisfying people's expectations is a common sub-code in service design and local festival planning. Creating experiences starts with understanding and satisfying the expectations of attendees, as mentioned above. If the desired expectation of a local service or festival specifically matches the actual experience, people will be satisfied and have more memorable experiences; if people enjoy the local service or festival, they will consider to visit the region again.

Designing story-centred sequential touchpoints is a sub-code discovered in local service design. Service design emphasises the sequence of service to create valuable experiences. Service flow is crucial to consider when designing services, as the rhythm of service influences the mood of users. Sequentially designed touchpoints are like an interesting movie that keeps the audience entertained. Story-centred touchpoints encourage people to be mindful of the local region based on the stories. Service design must not only make clear connections between locations and experiences but also be consistent in supporting the unfolding story or the underlying narrative theme.

Reflecting local identity is a sub-code discovered more frequently in local festival planning. Reflecting on local culture and identity is significantly valuable events are used to represent the place or culture, like selling the identity or culture as a product. Festivals representing local characteristics and culture generate interesting tourism experiences for attendees.

4.4 Receiving feedback on an iterative process

Receiving feedback on an iterative process is the last shared requirement for service design and event management. In terms of this requirement, one commonality and two contrasting characteristics were identified in local service design and local festival planning.

People assessment for improvement is a common sub-code in local service design and local festival planning. Local services are usually consistently operated. Although local festivals look temporary, they are conducted every set period. Hence, both local service design and local festival planning look for ways to operate more sustainably. Both domains receive audiences' feedback to improve services or events.

However, there is a difference in the objective of each domain. Continuous assessment and execution are a sub-code discovered in local service design. Service designers usually receive feedback for local services being developed or enacted. Since local services target limited populations, listening to users is crucial to maintaining sustainability.

Assessment for the future festival is a sub-code discovered in local festival planning. While service designers often conduct user assessments in every service phase, event planners usually receive attendees' opinions after the event and apply those opinions to future events. This is because local festivals are too short to apply attendees' opinions in the middle of the event, and chaotic situations can occur without enough guidance.

5 Discussion

Although local festival planning already shares many aspects with local service design, some perspectives and approaches are different. This study focused on opportunities for local festival planning to adopt perspectives, methods, and tools from service design thinking.

5.1 Deep understanding of target groups in early-planning stages

Service design utilises diverse tools and methods to understand users in the early service design stage. On the contrary, post-event activities are more frequent in local festival planning. There is a practical reason why local festival planning commonly focuses more on surveys in the post-event phase; the success of local festival planning is judged through surveys, which is the easiest, most effective way. The results of the survey can help form a standard of judgment as to whether the festival is economically valuable. Thus, if results fall short of expectations, the festival may not be held again. Therefore, understanding target attendees in the pre-event stage can help the festival achieve higher scores in the post-event surveys.

Various useful methods to understand people exist in service design. Among them, participatory design is an effective method to gain a deep understanding of users and is commonly used in service design. Many design studies have demonstrated that engaging people is an effective method in public matters (Crivellaro et al., 2014; Teng, 2014). However, it is difficult for people to process the tremendous scale of a whole local festival plan. The organiser can get meaningful ideas by filtering rough ideas iteratively so that only the strongest, most resonant ones are developed. Consequently, the planner can design the festival effectively to satisfy people's expectations through the process of understanding target attendees.

5.2 Building mutual trust with local stakeholders

Building mutual trust is an important issue in service design; local festival planning should not only consider attendees but also local communities and stakeholders. Occasionally, stakeholders have conflicting interests. For example, a local festival might make a region overcrowded or festival attendees might pollute the surrounding environment. Therefore, collaborating with all stakeholders is necessary to create a shared vision and understand and respect each other.

Moreover, active members of local communities know that unexpected issues can occur. There are cases in which listening to stakeholders' opinions led to successful results (Chou, 2018); thus, by letting local citizens and stakeholders participate in the process of planning a local festival, organisers can consider local needs and help the local economy.

Nevertheless, managing stakeholders as resources is still a considerable task, and some conflicts between stakeholders are hard to resolve under limited budgets. Therefore, finding a balance between them helps to establish an economical and competitive local festival.

5.3 Establishing stories of the region

Managing touchpoints is essential for service design—the user experience consists of certain touchpoints, which can be considered puzzle pieces of the service; the puzzle pieces should be connected to form a picture of the whole service. Drawing a service picture is like writing a story, and the whole service can provide users with consistent, unique experiences.

Reflecting local identity and stories in festival planning is important. Local festival planning can easily utilise the stories of the region's customs, residents' ethnic backgrounds, and unique cultural heritage. Background stories about the region and local festival can encourage valuable experiences and form a unique aspect of a festival; for example, La Tomatina in Spain and Palio di Siena in Italy. Applying the local identity is usually an influential method to encourage more attendees in the competitive festival market.

However, there are successful local festival planning cases that make their own stories and identities unrelated to the local regions, such as Santa Claus village in Finland. Saint Nicholas, the historic basis for Santa Claus, was not born in Finland but Turkey. A new identity for a local region can be built by composing a powerful story in local festival planning. Thus, if a historical identity is not enough to build a unique festival concept, a festival planner can create a story or identity to support the whole theme of the festival.

5.4 Utilising prototyping tools

In service design, designers collect users' opinions in the middle of planning or service processes to improve services over time. To test the results of user discussions, prototypes are utilised as effective means to convey knowledge and progress toward an outcome. The prototypes enable planners to explore, evaluate, and understand the possibilities and limitations of a design idea in the simplest and most efficient way (Lim, Stolterman & Tenenberg, 2008). When local festival planners collaborate with local people without knowledge of festival design, prototyping can help them easily explore ideas.

The relationships between local stakeholders are varied depending on each event, meaning that the process of planning local festivals cannot be simply standardized or unified. If service design tools for prototyping apply to local festival planning, event planners and local governments can easily discover difficulties and solutions before conducting the festival. Moreover, event planners and local governments can ideate the concepts of a local festival and communicate in a more efficient way.

5.5 Limitation and further research

This study provides for the possibility of adapting service design thinking to local festival planning. The limitation of this study is that the results were developed by a theoretical approach only. The study is based on a literature review and content analysis, meaning that not all specific practical application approaches were validated. Hence, to complement this limitation, possible future studies can focus on establishing more guidelines for practitioners in the field of local festival planning and validating the guidelines by performing empirical studies.

6 Conclusion

This study represents an investigation of the opportunity to adopt service design thinking to achieve more success in local festivals. Through literature review and deductive content analysis, the shared areas between service design and local festival planning are revealed.

Four requirements (priori codes) for successful services and events were found: 1) understanding target groups, 2) considering relationships between stakeholders, 3) creating experiences, and 4) receiving feedback for an iterative process. Second, using the priori codes, sub-requirements (sub-codes) for local services and festivals were extracted. Lastly,

these were classified and compared to find similarities and differences. These pointed to opportunities to adopt service design thinking in local festival planning.

Four main opportunities were discovered to use service design thinking in local festival planning: 1) deep understanding of target groups in the early planning stage, 2) building mutual trust with local stakeholders, 3) establishing stories of the region, and 4) utilising prototyping tools. All can contribute to creating better experiences at local festivals by encouraging the involvement of all parties. However, there should be more guidelines for local festival planners to successfully adopt service design thinking in their processes.

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Banking Outside-in: How Design Thinking is Changing The Banking Industry?

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The banking industry is facing unprecedented changes. From the assault launched by various Financial Technology companies (FinTechs), to the shifting customer needs and expectations, banks need to transform itself to remain relevant in the digital age. In this paper, we seek to explore the relevance of design thinking as a method to help banks cope with the disruptive changes. We review the biggest drivers of disruption in the banking industry, the suitability of design thinking for the banking industry and banks' current approaches to design thinking. Lastly, a case study on a Bank in Singapore is introduced to illustrate the example of application of design thinking for a new product design in banking and discuss opportunities and challenges.

Keywords: Design Thinking; Bank; FinTech; Innovation; Design

1 Introduction

The rise of FinTechs – new players or startups that specialise in financial services – is disrupting dominant players in the banking market. The popularity of new payment systems like PayPal, Apple Pay, Alipay, Android Pay, Venmo, Samsung Pay, and M-Pesa, indicate a decreasing customer satisfaction and trust advantage on banks (Winch, 2014). In the United Kingdom (UK), it is estimated that one in four bank branches will vanish in the next five years, while in the United States, over 1,700 banks closed in just 12 months as customers needing over-the-counter transactions declined (Louise, Rexrode, & Jones, 2018).

The decline of banking implies a failure to innovate amid a tide of digital disruption. The traditional banking model is being contested as customers grow disillusioned and form new expectations. In fact, a survey suggested that 7 out of 10 millennials in the UK would use a financial service mobile app offered by tech giant (Eurobank, 2018). Innovative approaches in business strategy and development are therefore imperative.

One of the most important concepts that have driven successful innovation in several industries is the concept of design thinking (Jamain, 2014; Beckman & Barry, 2007). Design thinking is defined by IDEO CEO and President Tim Brown as a "human-centered approach to innovation" which takes into consideration people's needs, technology, and the requirements for business success (Brown, 2008). Despite its popularity and success, design thinking is still significantly under-researched (Clark & Smith, 2008; Suciu & Baughn, 2016) in the business context. There has been scant academic research on the experiences

or the opportunities that design thinking offers to the banking industry, especially in the non-Western world.

In this paper, we aim to explore the opportunities of adopting design thinking in banking, focusing on the following questions: What are the biggest drivers of disruption in the banking industry?; Why is design thinking suitable for the banking industry?; How can design thinking be used in banking? We explore these questions through literature reviews and a case study on one bank based in Singapore. Our aim from this study is to identify key research themes related to design adoption in banking and envision relevant strategies, processes and tools.

2 Why banking is ripe for disruption

2.1 Where the banking industry is now

Without a doubt, the financial services sector, of which the banking industry is the largest, is a crucial segment of the contemporary global economy. Over the past decades, however, the banking industry has experienced disruption that forces its players to revisit the way they do business. For example, JP Morgan Chase Chairman and CEO Jamie Dimon famously remarked in a letter to investors about Fintechs: “They all want to eat our lunch. I mean every single one of them, and they are going to try” (Shontell, 2015).

The digital disruption in the banking industry does not only cover mere technological changes or the arrival of new players, but an upheaval of the entire retail banking model due to changes in the market structure (Ferrari, 2016). FinTechs pose a very powerful competition through digitisation of financial services. On the other hand, robo-advisory tools adopted under Industry 4.0 are becoming increasingly popular (Mlađenović, 2018). Furthermore, Big data, Internet of Things, Analytics, Machine Learning, and new analytics capabilities need to be utilised to improve work process and customer segmentation (de Galhau, 2016). Already, many banks are doing business by going cashless (Tee & One, 2016) and essentially, completely disappearing – by doing “invisible banking.” Under these current conditions, it would seem that the digital bank is the “bank of the future” (Dermine, 2016).

2.2 Disruption theory

Disruption refers to the theory pioneered by Christensen (1997) who traced the rise and fall of players in the disk-drive industry and how the industry changed hands from the dominant to the new entrant. Disruption theory hypothesises that where incumbent firms possess values that stop them from exploring opportunities despite having the capacity to do so, thereby allowing other entrants known as “disruptors” to take advantage of this opening.

In narrowing the focus on what currently works for the firm, incumbents resist market-driving value innovation. As a result, the disruptor becomes the player exploiting the chance to introduce a new value proposition to the market, which are usually attuned to mainstream customer needs, and at a cheaper price. Thus, any industry disruption may be considered as a development that could either marginalise the incumbent or altogether destroy it (Arnold & Jeffery, 2016). Disruption theory proposes that any product innovation, which would otherwise be viewed as inferior by an incumbent firm, may actually be regarded as superior by a sizable market segment. Thus, disruption theory underscores the recognition of the importance of innovation as a solution (de Galhau, 2016).

2.3 Drivers of disruption in the banking industry

2.3.1 Shift to customer focus

Many studies posit that the financial crisis of 2008 has eroded consumer trust on the entire financial services sector (Järvinen, 2014; Gillespie, 2013). A consumer survey pointed out customers perceived banks with descriptors such as “greedy,” “unsafe”, “untrustworthy,” and “putting profit before people” while only 21 per cent believed that UK banks are learning from their mistakes and changing their ethical behaviours for the better (YouGov-Cambridge, 2013, p. 8).

Other empirical research describes this weakness in traditional banking as a lack of empathy and customer focus (Culiberg & Rojsek, 2010). Many studies support the need for banks to rate highly on empathy and reliability to boost customer satisfaction (Chu, Lee, & Yu, 2012; Culiberg & Rojsek, 2010). Trust, empathy, and engagement are some characteristics that modern customers now seek in their financial service supplier. This means coming up with mechanisms to allow customers to be open, honest, communicate about their problems, and consequently, build trust (Chu et al., 2012). Compared to incumbent firms, making customer focus paramount is what differentiates FinTechs. FinTechs rely on a deep understanding of the customer’s needs and wants by continually offering upgrades on services and offerings, find solutions to challenges, and fuel innovation (EY, 2017a).

2.3.2 Digital revolution

Rapid advances in information technology and mobile devices have already undergirded some of the most groundbreaking innovations in financial services. For instance, the movement towards a cashless society has been implemented in countries like Nigeria (Ezuwore-Obodoekwe et al., 2014). Technologies such as the radio frequency identification (RFID) and near field communication (NFC) have gained increasing acceptance and application. Innovations such as Lollapalooza’s Lolla Cashless, which allows one to pay through a wristband, are capturing the imagination of the millennial market. High-tech giants have also rolled out its own payment systems such as Apple Pay, Google Pay, and Samsung Pay. The rise of Quick Response (QR) codes, which are black and white codes read through scanners and enable payment, also indicate how the trend is veering away from the usual brick-and-mortar branch model of banking. QR codes are popularly used in Japan and China, facilitating $1.65 trillion of mobile payments in 2016 alone (The Economist, 2017).

2.3.3 Changing customer expectations

Rapid digitisation in commercial services has bred greater expectations of convenience among customers. Such expectations are likely to intensify as technologies evolve rapidly to offer voice-activation, artificial intelligence (AI) capability, and real-time transacting (EY, 2017b). Hence, customer expectations with respect to payments and other financial services include speed, convenience, cost, and user-friendliness (du Toit et al., 2018).

Moreover, demographic factors are driving this shift. The increasing influence of so-called millennials or “digital natives” amplifies the preference for FinTech and the drive for customer-driven design (McCarthy, 2015). In a study, it showed that this market demographic trusts new FinTech entrants more than traditional banks in payments (Milne & Parboteeah, 2016).

2.3.4 Changing market structure

As a result of changing customer expectations and rapid digitisation, the market structure of the financial market has changed (Financial Stability Board [FSB], 2019). Increasingly, digital disruptors are winning new clients and cannibalising the market shares of incumbent banks. Agile and innovative, new entrants provide fresh and exciting ideas to financial services which existing universal banks are unable to.

Consulting group Bain opined in a report that the future of the banking industry is hinged on the ability to "leverage the power of customer insight, advanced analytics and digital technology" (as cited in Marous, 2018). To stay relevant and competitive, banks need to be able to improve their personalisation of the banking experience and offer services by responding to what customers need and want. Thus, banking is right for disruption and innovation, as a growing movement in the industry is calling to adopt design thinking or human-centered design (Wylie, 2017).

3 Design thinking applied in the banking industry

The application of design thinking in the banking industry is a relatively new phenomenon. While there have been case studies written on the potential that implementing design thinking can contribute to business success on health, education, engineering, and technology sectors (Patel & Khanjan, 2017), there is sparse literature on the application of design thinking or human-centered design on the banking industry. In this section, we unpack what elements of design thinking the banking industry finds relevant for its innovation and review existing cases around the world.

3.1 Suitability of design thinking for banking industry

Until now, there is no consensus on a standard definition of design thinking. One of its foremost champions Tim Brown, CEO and president of IDEO, suggested that design thinking refers to a "methodology that imbues the full spectrum of innovation activities with a human-centered design ethos" (Brown, 2008). David Kelley defines it as "a method for how to come up with […] breakthrough ideas that are new to the world, especially with respect to complex projects, complex problems" (Camacho, 2016, p. 88).

What Brown and Kelley identified, (i) the human-centeredness of innovation and (ii) identification of breakthrough ideas were seen as the most important factors in helping banks assess the suitability of design thinking. In a small market like Singapore, there were already 119 banks competiting for a same set of clients based on very similar product offerings.

The hyper competitive banking industry is hard pressed for change, and combined with the above mentioned drivers of shifting to customer focus and digital revolution have contributed to banking industry's adaptation of design thinking. Banks needed to move from business and technology driven decision making and embrace cusomter's insights. They also needed to digitize their offering, but not without capturing the inputs from their customers. In the below industry analysis, we saw that early adopter banks have started to use design thinking as an unique differentiator in the way their products are designed.

3.2 Review of the precedent cases

3.2.1 Hungarian banking industry

Feher and Varga (2017) undertook an exploratory applied research to surface the customer-centric challenges faced by seven Hungarian banks using the design thinking approach. The research was premised on the need for banks to gain deeper insight into what customers

want, identify these problems, evaluate the challenges faced, and ideate solutions. The authors modified IDEO's five-step approach and came up with their "One Week Sprint" methodology, which consisted of the following steps:

1. Preparation: problem mapping based on stories
2. Discovery: learning from industry experts
3. Interpretation: documentation of experiences such as stories, post-it notes, visual reminders to identify the need and problems needed to be solved
4. Ideation: brainstorming of ideas
5. Experimentation: presenting the idea through a storyboard, PowerPoint, or one-page business model canvas, and get feedback
6. Evolution: pitching the concept, risk analysis, tracking progress and learnings

The results of the study indicated problems in the role of the bank branches, online and mobile phone services, and products and services, as well as several digital solutions ideated. For one, young customers viewed going to the branch as an annoyance and when customers need to personally appear, the waiting time was long and dull. During the ideation phase, the group came up with ideas such as providing tablet games to know customer intentions while waiting, providing multi-functionality in mobile banking services such as augmented reality, and visioning of an online bank where important personal data is readily available.

3.2.2 National Australian Bank

The National Australian Bank (NAB) partnered with consulting group Oliver Wyman to provide customer-centric solutions for their small and medium enterprise (SMEs) clients (Oliver Wyman & IESE, 2017). Using the five-step IDEO design thinking methodology, NAB utilised the "day in the life of" tool to relive how clients experience the lending process, leading them to define that the process was complex, time-consuming, preference of unsecured products, and preference for mobile services. From the ideation process, an online application called the NAB Quickbiz Loan was formulated. This app consisted only of three steps and tied to a cash-flow credit model that allowed SMEs to secure up to $50,000 in business loans, with a decision-making time of 60 seconds and three days funds disbursement (Oliver Wyman & IESE, 2017).

3.2.3 Deutsche Bank

Germany's Deutsche Bank endeavoured to promote design thinking organisationally by starting with their IT department first rather than imposing it on the entire organisation. It first partnered with design thinking experts as well as a small design thinking team in the department that focused solely on completing successful projects. The design thinking transformation at Deutsche Bank went in three phases: Learning (P1), Adapting (P2), and Diffusing (P3) (Vetterli, Uebernickel, Brenner, & Petrie, 2016). Once the IT community started observing results from this design thinking team, the adaptation of design thinking proceeded step by step. Soon, the design thinking community in the bank grew to 150 members in IT who shared and exchanged knowledge with others. This effort led to the completion of the first prototype in less than a year, and the second prototype in less than 18 months. In five years, eight customer-centric projects were completed. After this "subversion" was considered adequate, design thinking was embedded in the company with the hiring of a Vice President for Design Thinking (Vetterli et. al., 2016)

3.2.4 Singapore Banks

In Singapore, the pioneers of design thinking in the financial services are DBS Bank and OCBC Bank, both awardees in design and service excellence. DBS Bank, acclaimed by Euromoney as the “world’s best digital bank” (Groenfeldt, 2018) rolled out their first successful design thinking project ‘DBS Home Connect’ in 2013. Fueled by a leadership that is passionate and serious about entrenching design thinking, DBS transformed its technology infrastructure to accommodate Big Data, AI, and biometrics (DBS Bank, 2016).

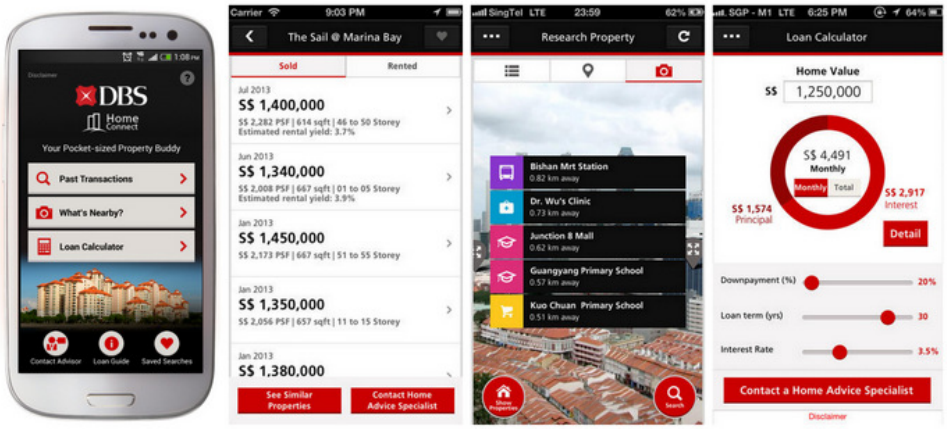

Figure 1. DBS Home Connect. (Source: DBS Bank)

DBS Home Connect was the result of several customer consultations and ideation that led to a smartphone app which allows users to calculate mortgage payments for home buys and check information on previous transactions, including rental information (Tan, 2013).

OCBC Bank implemented design principles in its innovation efforts. In coming up with solutions, OCBC used customer insight, co-creation, community engagement, stakeholder involvement and experimentation, adapting from IDEO’s five-step design thinking method. For example, OCBC Bank developed a family and kid-friendly bank policy called OCBC Full-Service Sunday Banking using design thinking. The bank used the diary research technique to produce an “outside in” perspective, focus group discussions, moment mapping for prototype and testing, and learning labs for learning (Wah, 2013).

The above-review of the precedent cases leads us to identify a few common patterns on the adoption of design thinking in the banking industry. Firstly, the initial adoption of design thinking is typically influenced by the framework and processes of IDEO. The popularity of IDEO’s framework could be attributed to the many successful case studies they have under their belt that covers a broad spectrum of industries (see Brown, 2008). Secondly, after the initial usage of design thinking the broad sentiment is to localize the design thinking process to suit the bank’s own process and type of customers engagement they are involved in. Thirdly, design thinking projects are first used on retail/mass customer segment rather than corporate or High Nett Worth (HNW) customers as retail customers are easier to engage and to apply design thinking on. Corporate or HNW customers are typically harder to engage to demostrate the value of design thinking.

4 Case study

The previous section gave us a broad base understanding of how design thinking has been used in the banking industries around the world. In this section, we will introduce a case study so as to examine in more detail, firstly, in what kind of formats or processes design thinking is adopted in the actual innovation project in the bank, secondly, what kind of

benefits design thinking brings to the bank, and lastly what are the limitations in its current adoption. The case chosen is the Smart Senior pilot program (DBS Bank, 2018) by DBS Bank in Singapore launched in May 2018. Smart Senior is an initiative launched by POSB (a fully owned subsidiary of DBS Bank) to help the senior citizen embrace digitization and cashless payments. Singapore defines elderly residents as those 65 years old and above and in year 2018, that accounts for 13.7% of its total population of 5.638 million (Department of Statistics Singapore, 2019). This is in alignment of the broader Smart Nation agenda pursued by the Singapore's government and also by the bank (Smart Nation and Digital Government Office , 2018). This program was launched by DBS Bank/POSB, in partnership with the Yishun Riverwalk Resident Committee (RC) and Republic Polytechnic (RP).

In this project, DBS Bank's Innovation Management team played the coaching role, guiding the students from RP instead of conducting the in-depth interviews and observations for design thinking due to the two reasons of (i) shortage of manpower, as the project required large number of interviews within a short span of time. The RC advised that the team had two half-day sessions to engage sixty senior citizens, and (ii) as part of DBS' commitment to industry projects to upskill the students to RP and provide actual use cases for the students to experience the tools and theories learnt in classroom.

Table 1 POSB Smart Senior Stakeholders Introduction.

Stakeholders	POSB (Business)	DBS Bank (Innovation Management)	Republic Polytechnic	Yishun Riverwalk RC
Introduction	Subsidiary of DBS Bank	Innovation Management is the internal consulting team of the bank, consisting of mainly design-trained consultants and designers	RP is an institute of higher learning in Singapore, providing diploma-level (pre-university) education to post-secondary school students	The Yishun Riverwalk RC is a volunteer-driven organization to promote cohesiveness within the community of their respective zones
Staff involved	5x Product Managers and analyst	4x consultants/designers	50x students from Diploma in Business and Social Enterprise (DBSE) 2x lecturers	5x RC management committee members
Roles and responsibilities	Funding of initiative Product development and management	Coaching POSB, RP and RC members through the design thinking process Training the RP students in interviewing techniques Collation of insights Design of product	Learning interviewing techniques from DBS, with no prior knowledge/skillsets Conducting of interviews	Liaison and management of senior citizens who would come for interviews Recruitment of pilot participants

Source: DBS Bank.

4.1 Adoption of DBS Bank's Journey Thinking Framework

DBS Bank's Journey Thinking 4D framework is the bank's adaptation of the UK Design Council's Double Diamond design process (2019), with the four steps similarly named as discover, define, develop and delivery (Figure 2). The process and tools used by DBS Bank is largely aligned to the five-step methodology of design thinking mentioned above. Design thinking was chosen as the issue is one that is rooted in the human's behaviours, habits and preferences. As DBS have also seen limited success with previous senior engagement projects, the iterative approach allows the project team to iterate and test before deciding on a firm outcome for implementation.

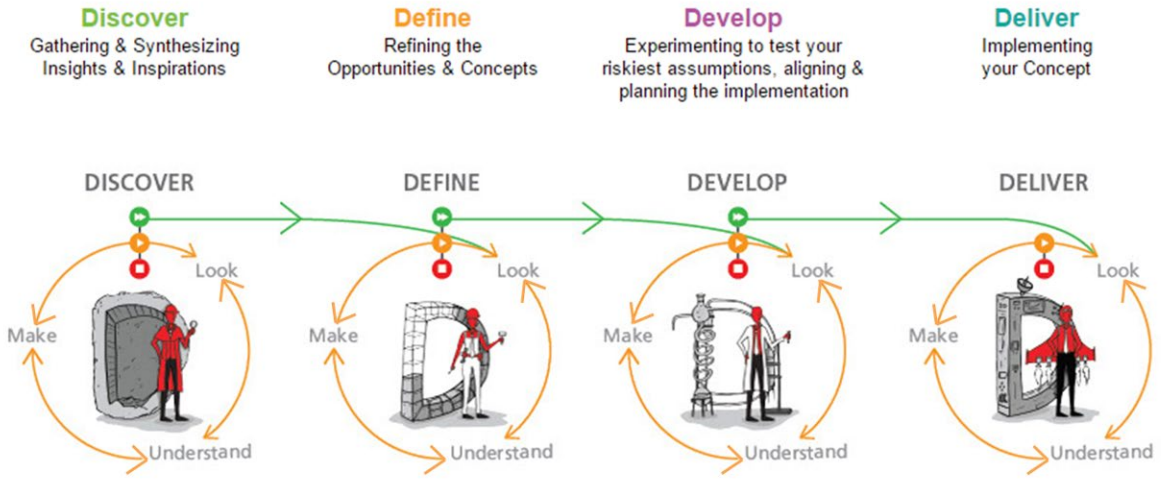

Figure 2. DBS Bank's 4D framework. (Source: DBS Bank)

In Discover phase, the DBS team collaborated with the students from RP to discover the needs, pain points and problems of sixty selected senior citizens. To enable the students to conduct the focus groups effectively, a training and demonstration was conducted by the Innovation Management team of DBS bank to help them understand in-depth interviews and observation techniques. The key findings from the user research by the students focused on day to day lifestyle and habits of the elderly, their social relationships and networks, their financial attitudes, and lastly their experiences on digital platforms and cashless payment.

In the Define phase, DBS Bank and People's Association gathered together for an ideation workshop to identify the opportunity areas. At the end of the workshop, the participants identified four smart value propositions of smart payments, smart transport, smart communication and smart fitness. These four smart features will be designed into a card sleeve, worn around the neck, as they observed elderly wearing similar lanyards in the past and would face less implementation barrier as compared to a format they are less familiar with.

In the Develop phase, user testing was conducted to understand if the four key features were aligned to what they wanted. They were presented with a concept board, with write-ups of the features in different languages (Chinese, Malay, Tamil and English) and different versions of how the wearable devices could look like (see Figure 3).

Figure 3. Different versions of the proposed wearable device for experimentation. (Source: DBS Bank)

Based on the inputs captured during the user testing sessions, the elderly wanted to have a more flexible format that could be worn in different ways. Apart from form factor, the respondents also gave various inputs on the effectiveness of the pedometer, use cases of cashless payment which were all captured for subsequent considerations.

Taking all the feedback into considerations, DBS moved into Deliver phase by issuing a RFP (Request for Proposal) and identified a partner to help manufacture the devices. 62 participants were selected from the Yishun Riverwalk district to take part in the three-months pilot. The selection criteria include being a resident of the Yishun Riverwalk community that is launching the program, being cash dependent. The program would allow DBS and PA to understand if elderly would switch to cashless payment methods and if the behaviour would remain after the program concludes.

Figure 4. The Smart Senior Package (Source: DBS Bank)

The eventual package produced by the vendor is one that is flexible and convenient, with various ways of attaching the card sleeve (see Figure 4).

4.2 Outcomes

> "I was very excited when I first heard of the POSB Smart Senior Program, as I can do so many things with just one device! Now I can try using contactless payments when paying for my morning cup of coffee!"
> Mdm Morie Lim Teck Cheo, 60 years old, Yishun Riverwalk resident (DBS Bank, 2018)

The Smart Senior pilot was officially launched on 5th May 2018 by Education Minister Ong Ye Kung. The three-months pilot concluded in August 2018 and provided the bank with a rich opportunity to understand and observe the cashless usage of the elderly. The outcome of the pilot was encouraging. The active engagement was observed from all 62 elderly participants and cashless numbers went up. Some highlights of pilot outcome include:

- 40% of elderly converted to cashless methods over the course of three months
- Step tracking is a popular feature that was heavily utilized
- Smart communication feature proves to be unpopular as many elderly were opting out of it
- Many elderly reverted to carrying the elderly concession card instead of using the wearable device as it offered them a cheaper fare
- The wearable format did not reduce the fear of elderly losing their card

4.3 The Role of Design Thinking

After the conclusion of the Smart Senior Program, the Innovation Management team of DBS Bank conducted a series of in-depth interviews with key stakeholders who participated in the pilot to discuss the learnings and takeaways from this pilot, and the process of Journey Thinking was mentioned in several instances:

4.3.1 Strong focus on customers

As compared to the usual problem solving framework of the bank, where customers were rarely consulted and decisions were driven by business profitability and technology feasibility, design thinking provided two opportunities where all the stakeholders would have to engage the customers in an in-depth way.

First of all, while the Product Managers from POSB had years of experience engaging the senior citizens, and the RC volunteers work with their residents on a daily basis, there were blind spots in their understanding and assumptions that they have formed up over the years. The focus groups and test gave them an opportunity to clarify their doubts and most importantly listen to the senior citizens instead of coming in as an expert to solve their problems.

Secondly, the experiments also gave the team added confidence on the robustness of the insights and helped the Product Managers adjust the value propositions before launching it into the market. This gave the team assurance on the desirability of the product, which was absent in traditional decision making process.

4.3.2 Rigorous process for analysing and communicating insights

While surveys were conducted in the past, the product team in DBS bank often did not have the tools to conduct more in-depth analysis of the data captured. The channels of engagement also did not afford the team such an opportunity to dig deeper. By embracing

the approaches of design thinking, the team felt that the post-interviewing process of writing verbatims, clustering them according to themes identified and the writing of insights statement is a much more rigorous process as compared to relying on superficial survey data. The team knew exactly which verbatim and thematic clusters contributed to the insights. This not only gave the sponsors greater confidence that the insights were sound, but also helped the subsequent ideation process where the team had much more in-depth context around the insights to ideate on.

Before embracing this new way of working, insights were largely used as a loose term, anything and everything could be an insight, and the experience of the person identifying the insights then became paramount in ensuring good outcome. The person collating the data and writing up insights also needs to be present during ideation otherwise we run the risk of losing precious context. Design thinking brought replicability of the insight process which is well appreciated by the team and also their sponsors.

4.3.3 Experiments and iterations

The running of experiments to test value proposition is a completely new way of working for most stakeholders on the project. Prior to Smart Senior, the Product Managers in POSB/DBS Bank were exposed to the concept of running User Acceptance Testing (UAT), which centered around user interface, experience (UI/UX) and less of the core product value proposition itself. Those tests were built on the assumption that the product was what the customers wanted, which is a huge risk the Product Mangers had to bear. The rapid iteration model introduced by design thinking required the Product Mangers to make quick decisions or tweaks for the next round, helping them see a difference in desirability within a short turnaround time, with no additional investment.

In a post-interview conducted with the POSB Product Manager, they mentioned that even if they do not adopt the whole process in their next project, they will ensure that they experiment and test before launching any products into the market in the future.

4.4 Limitations

In the case study of Smart Senior Program, it was initiated by the management of DBS Bank and the Yishun Riverwalk RC. With a top down mandate, the team was given the required resource, and time to co-create a desired outcome.

The conducting of interviews, running of ideation session, and conducting of experiments take time, causing many to revert back to the usual way of working, by jumping straight to a potential solution based on their experiences. The unrealistic expectations of sponsors very often get into the way of conducting rigorous research, as they would try to compress certain stages of the process from weeks to days.

Another common pain point was the lack of trained personal to lead the teams through the design thinking process. Only high prioritized projects such as Smart Senior got the help required, and others would have to wait or self-serve using the tools and framework of the bank. In addition to the leadership support, a more robust training and support model would also help operationalize design thinking in a better way.

5 Discussion and Conclusion

By improving the entire customer experience, design thinking enhances customer relationships and adds value to the value proposition of a banks business model. As

illustrated in the reviewed case studies, establishing design thinking as a pivotal element in business strategy can strengthen the bank's position as it ensures that customers' needs and expectations are addressed. Nevertheless, embedding design thinking is a complex endeavour. By following the insights captured and experimenting, not all results are going to be positive in the first instance as demostrated by the Smart Senior Program.

A strong leadership committed to change as exemplified in the experiences of DBS Bank's Smart Senior Program would be key to enable teams to learn and get better at each iteration. Design thinking can also pave the way for innovation not only of standalone banks, but of the entire industry, as illustrated in the Hungarian experience (Feher & Varga, 2017). While the reviewed case studies of design thinking application in banks paint a promising picture of how design methods can fuel innovation, the field still requires more rigorous, holistic and systematic methods to address complex stakeholder relationships and incorporate very recent approaches like data analytics.

Many products and services rolled out using design thinking methods also need time to prove the value it brings, to help ensure continued usage and commitment. More studies in the Asian context also needs to be pursued as the Asian financial industry has evolved rapidly and has seen less dependencies on western markets. With Asia looking increasingly different, it will be hard to generalize the western trends in Asia. Moreover, further studies investigating the relationship of design thinking to metrics of business success such as profitability should also be further explored.

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Co-creating FabLab La Campana: Empowering a marginalised community in the North of Mexico

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FabLabs are a celebrated approach to formal and informal learning through making with digital fabrication tools. This paper discusses the co-creation of a FabLab with a marginalised community in Monterrey, Mexico. One of the main challenges in establishing these Makerspaces is in sustaining the activities and community engagement on an ongoing basis. In responding to this challenge, this process focused on the empowerment of community members to make the changes they desire, either for themselves or their community. Beyond skills for making and playful engagement in STEAM learning, makerspaces also facilitate the building of networks and partnerships, and the development of social competencies and soft skills, that are often overlooked in the process of empowerment and social mobility. Primary insights from the co-creation process of the La Campana FabLab are reported here. A Mexican higher education institution with a strong social responsibility agenda facilitated the process, securing funds and connecting project partners, locally and globally. Framing the co-creation of the FabLab with the partners was and is an ongoing process. Key factors included the donation of a safe space and tools for the community to host and run the FabLab. Establishing the role of the FabLab in the community from the participants' point-of-view and committing to regular ongoing educational dialogue was important in forming an equitable partnership between institutions and community. Beyond the physical space, equipment and educational activities, a community architecture intervention demonstrated the large-scale impact digital fabrication could have in creating spaces shaped by and for the community.

Keywords: FabLab, makerspace, STEAM education, equity, empowerment

1 Introduction

The skill of making is in all of us. It might be hidden or dormant and need activation in some, or it might be seen as an undesirable activity, or a necessity to simply 'get by' in others. Makerspaces and FabLabs promise to reactivate and reframe this core human skill by linking it to new technologies of digital fabrication and a narrative around innovation and renewed sense-making. But does this promise hold for everyone? Scholars argue that FabLabs or Makerspaces, even in developing or middle income countries, still only serve

those with 'time, skills, and money to access these spaces' (Woodson, Alcantara, & do Nascimento, 2019). However, the promise of other non-formal educational spaces for developing STEAM (Science, Technology, Engineering, Art and Mathematics) skills have been documented as a successful in cases of marginalised conditions, including Mexico (Fernández-Limón, Fernández-Cárdenas, & Gómez Galindo, 2018; Montgomery & Fernández-Cárdenas, 2018).

Making something is the first step in exploring what one is capable of, i.e. producing something that makes a small change, improves a situation, addresses a personal problem, expresses something or is simply joyful and (aesthetically) pleasing. But how can this seedling take roots in communities that are historically excluded from the learning and development opportunities that these spaces offer? Many scholars agree that opening the doors to FabLabs and Makerspaces alone does not guarantee inclusion. The design and implementation of a FabLab that aims at inclusion needs to utilise a co-design approach from the start (Barton & Tan, 2018; Vossoughi, Hooper, & Escudé, 2016).

This paper reports on the co-creation of a FabLab in, with and for the marginalised community La Campana-Altamira in Monterrey, Mexico. Literature relating to FabLabs, Makerspaces and empowering marginalised communities through making is discussed before the co-design methodology applied in this project is introduced. The co-design process, emerging themes, and the establishment of FabLab La Campana, including on-going work, is subsequently presented and discussed.

2 Background

2.1 FabLabs and Makerspaces

The community maker and education space presented in this paper is connected to the FabLab network and is hence termed a FabLab, but the terms FabLab or Makerspace are often used synonymously. Literature from both strands is reviewed here. FabLabs and Makerspaces overlap in many of the values and principles they adhere to in making, collaboration, learning and sharing. One major difference is that FabLabs are often situated in higher education settings while Makerspaces more often exist in school or community settings. Both use digital fabrication tools to promote STEAM and design learning through creative hands-on making and experimentation (Martin, 2015).

Making not only improves individual wellbeing but also promotes community wellbeing (Yair, 2011). Makers are in a state of focused immersion when ideas are given a physical form and a state of pleasure when the maker discovers ‘how something works’ (Martin, 2015). Beyond this, professional and communication skills are also developed during the activity of making meaningful objects. The practice not only lifts the mood of individuals but also gives people the opportunity to bond and form relationships (Taylor, Hurley, & Connolly, 2016). The process of making instils feelings of confidence and engagement. It develops a can-do attitude, promotes self-development and leadership. The ability of an individual to see the impact of making on themselves and on a small community, empowers makers to activate change beyond the immediate maker community, for example in adopting sustainable practices (Charter & Keiller, 2016; Kohtala, 2017), or create links into local policy making (Lindtner & Lin, 2017; Zamenopoulos et al., 2016). Making has been linked to local activism (Garber, 2013) and due to its global reach it has captured governments’ attention and their support (Rainwater et al., 2016).

FabLabs and Makerspaces have gained in numbers across the world. They form global networks of individually run spaces. FabLabs encourage open innovation processes that help communities to become more sustainable (Ajuntament de Barcelona, 2014; Fleischmann, Hielscher, & Merritt, 2016; Kankanhalli, Zuiderwijk, & Tayi, 2017) or even self-sufficient (Fab City Foundation, 2018). There is huge variety in existing FabLabs and Makerspaces and they face many challenges relating to their viability and sustainability. Some Makerspaces cease to operate due to being overcome by day-to-day concerns. Prendeville, Hartung, Brass, Purvis, & Hall (2017) argue that building local connections and the nurturing of individual, as well as community capacities, is essential to enable a circular Makerspace economy. For example, the Fab Athenaeums in Barcelona (Spain), is a public FabLab created by the City Council where the FabLab acts as an intermediary between public and private sectors (Gascó, 2017; Kankanhalli et al., 2017). It aims to bring digital manufacturing to its citizens and support projects with a social return. Thus, through open innovation, citizen collaboration and debates across sectors, Fab Athenaeums promotes social transformation (Ajuntament de Barcelona, 2014). Similarly, the Makerspace Media Prado Lab in Madrid offers its users the opportunity to prototype artefacts as solutions for community problems, particularly with respect to innovative uses of public space (Estalella Fernández, Rocha, & Lafuente, 2013). In Mexico, the first public FabLab was created in Mexico City in February 2018, called 'Fábrica de Tacubaya' (Silva, 2018). It seeks to promote digital culture and to put contemporary technologies at the service of the imagination and the community (CDMX, 2018).

Calabrese Barton & Tan (2018) contend that even though the maker movement is built on an empowering vision, the potential for exclusion to this promise, especially in marginalised communities, should not be overlooked. A review of the citation index of research into Makerspaces and FabLabs, clearly shows that this research centres in the West (Chen & Wu, 2017), although the networks stretch across the globe. Similarly, some scholars criticise the global maker movements for strengthening a rhetoric around expensive gadgets/tools and commercial activity being accessed predominantly by the Western educated middle-classes (Vossoughi et al., 2016). In testing this argument, this paper seeks to address: How can a FabLab empower marginalised communities?

2.2 Empowering marginalised communities through making

Our definition of marginalised communities relates to those groups of lower socioeconomic status and disadvantaged conditions, who, in particular contexts, are at the fringes of society and tend to benefit less from education and its related services. Formal STEAM education is known to have limited reach to marginalised populations, but growing evidence suggests that the use of informal spaces as sites for alternative educational experiences should be explored more in this context (Montgomery & Fernández-Cárdenas, 2018; Rogoff, Callanan, Gutiérrez, & Erickson, 2016).

Engaging in hands-on making builds up professional and cognitive skills and, more crucially, confidence in one's own abilities. A key ingredient in this empowerment process is the critical engagement with, and the understanding of, what is made and how it is made. Linking making to STEAM education has been shown to create more insightful and deeper learning than making on its own (Barton & Tan, 2018; Vossoughi et al., 2016). Although STEAM education has been acknowledged to play a role in professional development, employment and entrepreneurial opportunities, several authors emphasise that the

marketisation of things made or practical skills gained through making should not be the means-end (Craft, 2013; Montgomery & Fernández-Cárdenas, 2018).

In the same way that makers transform materials, the processes of making transforms the maker. Making something empowers the maker in decision-making and change-making for themselves. This seedling of empowerment can be nourished and grown into something larger, taking the idea of active engagement beyond an object being made, to situations being changed. Craft (2013) calls for humanising creativity in which educators and students co-create alternative, enabling futures. Recursively, equitable partnerships also appear in the literature as key practices for empowerment. For example, Jones and Hussain ((2010) believe that in order to empower a marginalised community in the long-term, a participatory engagement approach with core community and independent partners is necessary (Watermeyer & Montgomery, 2018). Research in participatory practices concurs that there are as many approaches to it as there are projects (Saad-Sulonen, Eriksson, Halskov, Karasti, & Vines, 2018), so which participatory approach would work in engaging a marginalised community to co-create a FabLab?

Strengthening equitable partnerships became a core-principle in the ongoing co-creation of a FabLab in a marginalised community in Monterrey, Mexico, with the aim to empower the community through STEAM-rich learning and making. An outline and discussion of the strategies and approaches that underpin this co-creation process are reported below.

3 Methodology

3.1 Setting

Monterrey is a relatively prosperous and diverse city in the state of Nuevo León in the north of Mexico. The main research sites were Tecnológico de Monterrey and its neighbouring La Campana-Altamira community, which is a Priority Attention Area with high rates of poverty and social exclusion.

3.2 Co-design process

A long term, participatory community-design approach (Saad-Sulonen et al., 2018) was used to co-design and co-create a FabLab and associated making activities with members of the La Campana-Altamira community in Monterrey. The British Council in Mexico funded two projects associated with this research, both of which were led by academics from Tecnológico de Monterrey (a multi-campus private University based in Monterrey, Mexico).

In February 2018, the initial scoping workshop at Tecnológico de Monterrey involved 28 college students, 83 in-service elementary and middle school teachers (six of whom had positions at local government and NGOs), and 10 academics from Mexico and the UK. This experience brought practitioners, researchers, students, and community members together in the development of ideas for social innovation. The workshop addressed question around the complex problems of marginalisation based on socio-economic status, disability or race and ethnicity that are faced in their communities. A design thinking methodology was used to frame problems and prototype solutions to address these problems. Based on the positive feedback and impact of this initial workshop, follow-up funding was gained to implement one solution.

Then, from January 2019, a series of workshops and events involved a further 70 students from Tecnológico de Monterrey, 19 academics and professional staff from higher education

institutions in Mexico and three academics from the UK. A further two participants from the Insitu Foundation (Insitu, 2019) and 18 members of public authorities were also involved. The FabLab co-creation process also brought together 50 students from the CBTis 99 high school, 20 high school teachers, 30 primary school children, and 50 members of the La Campana-Altamira neighbourhood. Additionally, the FablatKids.org network manager for Mexico (FabLatKids.org, 2018) maintains weekly workshops with approximately 20 children attending each session.

A co-design approach was taken in the second workshop series in which partners and participants engaged at stages throughout the process. So far, the co-design process has been running for 18 weeks. An initial preparation stage involved community leaders and academics in planning and preparing the workshops (four weeks). At the secondary community scoping stage, academics and members of Insitu Foundation interacted with a wider group of community participants through walks, interviews, workshops and focus groups (four weeks). The core stage was the community co-creation, in which the full range of participants actively co-created the FabLab. During this stage participants set up the room and the equipment, designed and conducted making activities, and negotiated the partnerships, roles and responsibilities of participants and partners (two weeks). The Insitu Foundation used a well-tested digital fabrication and concrete casting methodology for co-creating community design interventions during this stage. During the final stage, which at the time of writing is the past eight weeks, weekly maker events held by the FablatKids.org Mexico network have been exploring the scope of the FabLab with a variety of activities. This co-implementation stage will last for approximately one year, during which new funding for further equipment, activities and research will be sought.

3.3 Data collection and analysis

Qualitative data from design workshops, interviews, focus groups and community walks and mapping exercises were collected throughout the process. Notes, recordings and images were analysed chronologically and thematically and are presented as a case study in the subsequent sections.

4 The case of FabLab La Campana in Mexico

4.1 Growing the idea

In 2018, the project “Reducing marginalization and promoting inclusive education with the mediation of digital technology” produced 17 social innovation proposals for intervening in the impoverished district Campana-Altamira, Monterrey and in other educational settings elsewhere in Mexico. One of these proposals was the installation of a FabLab in the Campana-Altamira district in order to empower citizens to manufacture goods using 3D printers, laser cutting machines, and other digital tools (Figure 1). The initial idea was that products could be sold and allow the creation of a different local economy and a better income for participants.

Figure 1 Prototype for La Campana (The Bell) FabLab in 2018

Building on a unique partnership between higher education and secondary education institutions as well as the local community and maker networks, this idea was developed into a proposal for a follow-up project and funded in 2019. The aims of the project were to:

1. Co-design and implement a FabLab in a marginalised district in Monterrey, Mexico.
2. Develop methodologies for engagement and learning through making for higher education students and high school students.
3. Develop strategies for improving social mobility of disadvantaged students and community members, to facilitate their access to better jobs in a knowledge economy afforded by digital technology.
4. Connect with an international network of FabLabs to improve the quality of STEAM education for marginalised groups.

4.2 Framing co-creation

A simple framework for co-creation of the FabLab was developed and refined with the Campana-Altamira community in a series of diagnostic workshops. The framework consisted of 4 pillars: technical making, creative making, sharing/communication and management.

In a preliminary workshop, the community's desires and ideas around the questions 'What do you make?' and 'What would you make?' were investigated and their contributions were categorised. Technical and creative making, and the sharing or selling of objects made were identified by the participants as key objectives for their engagement in the co-creation process. This response was tested with the community in a follow-up making workshop incorporating all these aspects, which asked participants to create a simple light-object from found materials and share a story around this object (Figure 2).

Figure 2 Workshop creating light objects with light diodes, batteries and founds materials

Finally, participants were asked to rate their experience as positive (green dots) or not so pleasant (red dots) (Figure 3). The results were surprising and did not entirely correlate to the key objectives identified by participants during the preliminary workshop. Technical and creative making was seen very positively, but the communication of what had been made, the sharing of ideas and teamwork were only seen as desirable activities by half of the participants.

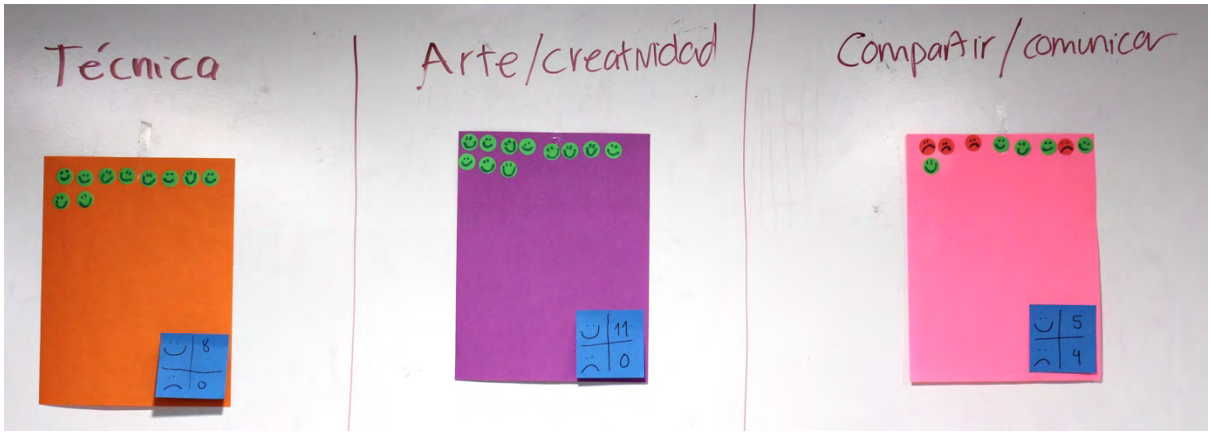

Figure 3 Participants' perception of Fab Lab core co-creation activities

The management of the Makerspace was added as a fourth pillar to the framework and collaboratively developed with the head teacher, subject teachers and students of the high school. A notable impact of these ongoing co-creation events was the provision of a dedicated space for the FabLab at CBTis 99, which had not been offered in the initial scoping contacts with the high school.

4.3 Engaging in playful and meaningful making at all levels

This co-creation process involved a diverse range of participants and partners. The activities and roles for academics, PhD students, professional university staff, undergraduate students from various disciplines (such as business, social sciences and engineering), plus the involvement of high school students, their teachers, and the wider Campana-Altamira community, families and social workers, as well as primary school children, needed to be meaningful and not onerous.

The Tec21 educational model (Tecnológico de Monterrey, 2019) requires undergraduate students to carry out social engagement activities, which count towards their qualification. This model promotes development of abilities to solve real-world challenges, which is considered as a meaningful activity by the university students. Students registered on the project formed teams around particular themes for the co-design process. These work-packages were 1. STEAM Education, 2. Digital Fabrication, 3. Research, 4. Community Co-creation, 5. Sustainability, 6. Communication and Marketing.

Students joined a team for the two weeks running up to the FabLab inauguration, with academics and PhD students mentoring each team. The teams carried out focused activities, which in many cases overlapped, so regular team updates were integral to the process. Mentors gave talks and workshops to introduce objectives and possible activities in each area. A group of up to 22 high school students, three subject teachers and several community members also participated in the talks, seminars and workshops leading up to the opening of the FabLab, despite being officially on term break. Their motivation was to learn how to work with new technologies and materials, train to be able to use the facility and to be able to teach others to use the FabLab resources.

The Education team planned and facilitated a series of engaging and fun making activities for the opening of the Makerspace and also for weekly workshops to attract different age groups (Figure 4). The Communication team recorded events and produced promotional materials for social media to invite further community involvement with the FabLab. The Research team evaluated the expectations of participants and the impact of the maker events. The Community Co-creation team talked to participants and partners throughout the process and developed pathways for active participation. The Sustainability team investigated different business and social innovation models, and the Digital Fabrication team produced the Maker Cart, FabLab furniture and games as well as the outdoor community installation.

Figure 4 Fun inauguration activities for all ages

4.4 Creating a safe space

When Mexico's Drug War was declared, the Campana-Altamira community, like many other low-income communities, became the centre stage of terrible open conflict and violence (Durin, 2019). The community members retreated and became isolated. With the peak of violence in 2012, a new policy of de-escalation of open Cartel and Government conflict led to a calming of the situation. Now, slowly, community members are seeking to actively remodel and rebuild their community (for example, see Colectivo-Tomate, 2019), but strangers to the community are still seen with suspicion. During an initial walk through the community, members reacted to our request to take a photograph to record a creative use of public space (Figure 5) with: *"Why do you want to take a picture of my son? Are you kidnappers?"* This was not meant as a joke.

Figure 5 Youth is 'performing' a haircut in a public market, the setup of which is reminiscent of a stage with bystanders and waiting customers as audience

One of the most important activities in co-developing FabLab La Campana was the negotiation of a safe space to host it, to which the whole neighbourhood would have access. CBTis 99, a high school in the centre of the neighbourhood emerged as a key partner. Access to this space was negotiated between the host (CBTis 99), workshop facilitators (Tecnológico de Monterrey and FablatKids.org Mexico) and users of the space (CBTis 99 students and La Campana-Altamira). The negotiation of a suitable space in the high school resulted in the donation of a classroom that was transformed into a permanent Makerspace (Figure 6). A 3D printer was purchased and 10 Computers were donated by Tecnológico de Monterrey. The 3D printer and other maker tools were provided in a mobile Maker Cart, which was constructed by the Digital Fabrication team. Maker Carts are often used in educational settings (e.g. Peppler, 2013). Due to the flexibility of the Maker cart, which while mobile can also be secured, the equipment can also be used in other community spaces, e.g. the community social room or Sunday Market.

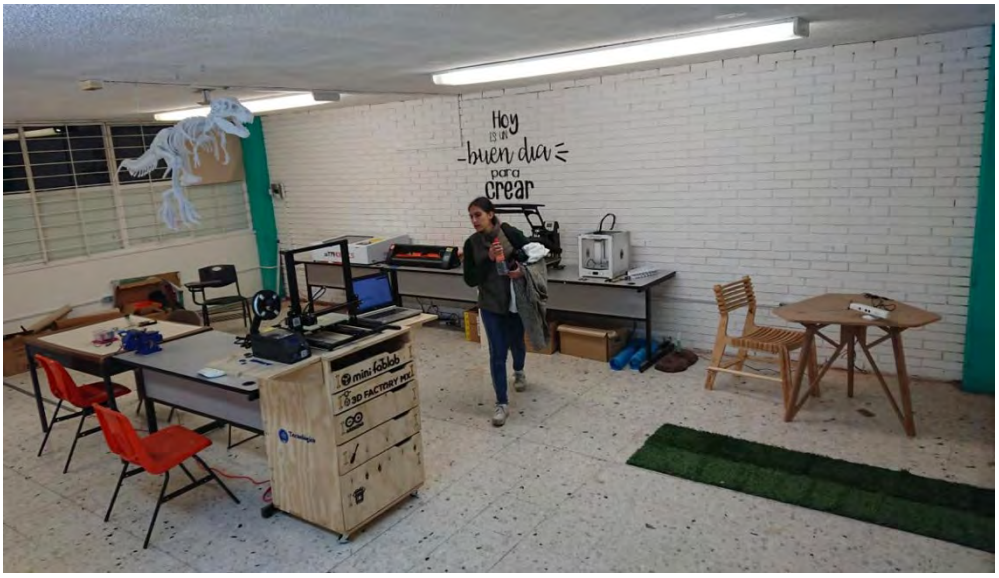

Figure 6 Fab Lab La Campana – a dedicated room in CBTiS 99 high school with Maker cart in the foreground

4.5 Creating transition spaces

Interviews, observations and community mapping activities of the urban and social context of the area have shown 'unsafe spaces' that facilitate anti-social behaviours (e.g. drug crime and violence, mugging, assault and illegal dumping) but also spaces that the community would simply like to use more or in a different way (e.g. a sports playing field that floods easily). Examples of community maps are shown in Figure 7 and a summary of key places for potential interventions are summarised in Figure 8.

Figure 7 Community maps showing desirable and undesirable areas and potential interventions

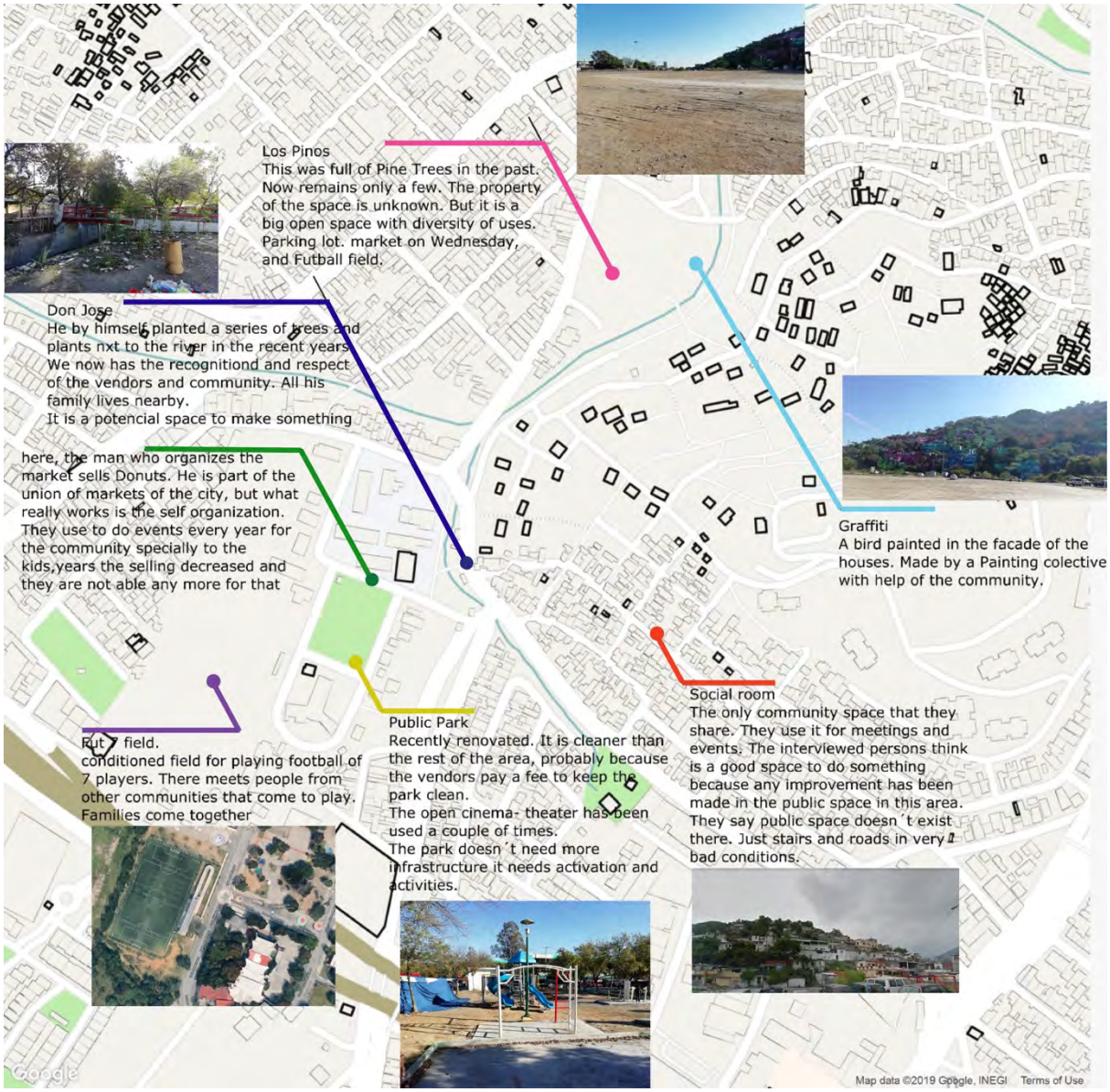

Figure 8 Summary of community mapping exercises

Key areas for improvement were identified from which a design intervention brief was elaborated. An ideation workshop with university and high school students, and their teachers, generated ideas for the intervention through brainstorming concepts based on geometric forms (Thomas, Capetillo, Diaz de León, Lopez, & Machado, n.d.). Ideas that developed ranged from seating furniture and hanging tools for the Sunday Market, planters, skate park and parkour objects and outdoor games.

The Insitu Foundation was invited to the project to employ a specific methodology. The aim of this work was to show how digital fabrication tools and concrete casting within a FabLab can achieve larger-scale elements for the community. A total of nine designs were translated into 3D models and five of these were cast in concrete. The use of concrete was a requirement in reducing the likelihood of theft. The final designs, shown in Figure 9, were intended to make the public park spaces more inviting and approachable. These pieces of community furniture seek to reclaim the spaces for the community, making them usable, aesthetically pleasing and safer.

Figure 9 Digitally fabricated community urban furniture/public installation

4.6 Sustaining engagement

Many community co-creation projects cease activity once the public funding ends. A key aim throughout this project was to find pathways to sustain the co-creation process and use of the FabLab beyond the funded period. Emotions at the inauguration were flying high and many promises of support were made. But a government official said: *"This is great, but I would like to come back on a Thursday afternoon and like to see how many are using the FabLab then."*

In collaboration with Tecnologico de Monterrey's Innovaction Gym and FablatKids.org Mexico, weekly maker events are organised at FabLab La Campana. One event linked-up several Makerspaces via video conferencing in order to present their work to each other (Figure 10). To this moment, the space has been used for high school project work and teaching specialised workshops on 3D modelling and electronics, as well as holding weekend workshops in collaboration with FablatKids. While the workshops during the week are aimed at teenagers, the weekend workshops are attended by a mix of university students, high school students, younger children and teachers, as well as community members.

Access to the space and resources are continuously negotiated. The high school has previously been involved in other positive community development activities, including

starting a school orchestra with the teenagers. Through the students' links into the community, adults also started to join the orchestra. The hope is that this snowball effect will be re-created with the FabLab to engage a wider community in designing and making. Early on, the community conceded that access to the FabLab needed to be managed more closely than it might be the case of other Makerspaces. Activities need to respond to events outside of their control. For example, the first workshop after the inauguration was cancelled because the city issued a security warning for the area. Currently, the lab activities are still managed by Tecnológico de Monterrey, but recently a potential community lab manager has emerged, who is night guard and concierge at CBTis 99. Slowly devolving the management of the lab to the community will make the coordination of access to the space and the facilitation of regular activities easier.

Participants, particularly teachers, were worried about resources to keep the 3D printer running. An idea the community immediately connected to was to produce their own filament. Using digital fabrication tools they could construct a shredder similar to that reported by Haldrup, Hobye, & Padfield (2018). Plastic bottles could be collected and recycled, which would also address the waste issue identified by the community. Much waste is dumped illegally, which deteriorates the value attached to these littered community spaces. A community activist has started guerrilla planting in the areas that are usually illegally littered. Our makers have built on this and installed the community furniture next to these planted areas. Building links with individual active community members with similar values to the makers is key for initial interventions to take hold.

Figure 10 Weekly workshop announcements and a video linked Fablat Kids workshop

Another example of building close and equitable relationships with the community is the close collaboration between a Tecnológico de Monterrey student and a community architect to help to install the community furniture. This has resulted in a continuing internship where students will not only develop professional skills, but also help to strengthen the links between institutions and the community.

5 Discussion: equitable making?

FabLabs and their claim regarding empowerment and value creation are not unchallenged (Barton & Tan, 2018; Taylor et al., 2016; Vossoughi et al., 2016). This project addressed many recommendations proposed by Bødker & Kyng (2018) and Vossoughi et al. (2016) in order to realise greater educational equity and sustainable participation in these Makerspaces. This was largely achieved through the application of a co-creation process from the inception of the FabLab. Involving marginalised communities in STEAM learning should not be built on a deficit ideology (i.e. asking why marginalised communities are less

engaged with STEAM learning). Instead, this process started by asking what the community likes doing and what they would like to make, and thus linked their responses to STEAM education and design activities, and the development of the learning activities offered. A co-creation approach made it possible to tap into what are usually scarce resources, such as a safe and dedicated spaces for maker activities or teacher training alongside students' training. A further development in this direction would be the involvement of more community mentors, i.e. elders with particular expertise or traditional skills.

There is a continuum of co-creation approaches ranging from community initiated and expert supported (e.g. designers/academics) to expert initiated with some participation of communities. FabLab La Campana sits somewhere in the middle of this continuum and sways from one to the other side at times. Negotiating ongoing engagement is the goal of a truly equitable partnership. Kraff (2018) has recently argued that participants' circumstances and engagement, particularly in developing contexts, continuously change and hence trajectories for participation should be continuously reflected on. The empowerment of marginalised communities is not a process that can simply be kicked-off and then runs by itself. Taylor et al. (2016) reported that a culprit in the failure of keeping a Makerspace alive is the insufficient demonstration of the impact that the space had on individuals and communities. Makers are often not able to measure and communicate these outcomes. However, this is central in securing or sustaining resource and engagement. During this project in particular, the skills to reflect on actions and simulate potential outcomes was observed to be challenging for many participants. These reflective skills take time and training to develop. Reflection on what was made, and how it was made, at least anchors reflection in something concrete - in action (Schön, 1987). This reflection on action has the potential to develop participant makers' overall reflective capacities.

A challenge related to this lack of reflection on making is the ability to communicate what has been made and what experiences were gained. Although many participants follow and like posts on the FabLab Facebook or Instagram groups, few makers share posts themselves. This could be explained by a perceived unequal power relationship and the right to post on the Social Media platforms of the FabLab, but an earlier workshop clearly demonstrated the fear of failure that these teenagers showed in front of their peers. A high school student said during the storytelling task: *"I don't know what to say about this more than this is a lamp".*

It has become clear that Makerspaces should not just teach making but also how to share knowledge of what was produced and how it was created to ensure everyone's voice is heard. Although the Social Media platforms were chosen based on a survey of what was used by the community, it might be that commercial Social Media networks are not the right formats for sharing making in this community. The MAZI project argues that commercial platforms and networks render users more and more passive. They have experimented with DIY wireless technology to share relevant knowledge in communities with those already living in physical proximity (Childs & Peachey, 2013).

Tech alone does not support how stories are told. There is a continued need to learn, to reflect on, and to communicate what should be shared and with whom. Bull, Schmidt-Crawford, McKenna, & Cohoon (2017) talked of 'storymaking' as a maker activity, combining coding and storytelling. Often, the youth want to play with tech, while older adults want to share their wisdom. A future making workshop could pair youth and older adults to tinker and capture stories at the same time. These stories need to be told in a non-exclusive language.

For example, processes of iteration, reflection and learning should not be labelled as failure. The ‘fail often to succeed earlier’ slogan publicised by IDEO will sound very off-putting to some communities. Raina (2018) maintains that in most developing economies, experimentation is viewed by craft-workers as wasteful and risky. Marginalised or impoverished communities may have more negative associations with failure, so that the intended positive meaning of Western mantras such as IDEO’s might easily be overlooked.

Connecting formal and informal learning communities needs ongoing dialogue and support (Saad-Sulonen et al., 2018). Some participants benefit by learning more about co-creation processes, while others learn to make or produce locally relevant designs through learning with technology. A different form of STEAM teacher training is made possible through engagement in the FabLab and the strategic partnerships between teachers in the community and educators in the university setting (Montgomery & Fernández-Cárdenas, 2018).

Any activity around the FabLab needs to be designed with multiple purposes in mind in order to be successful. The overlaps between these meaningful activities enable participants to co-design, co-investigate and co-make. The question of ‘Making of what (and how and why)?’ needs to drive pedagogies that help apply STEAM learning and design knowledge to everyday activities and settings (Fernández-Limón et al., 2018). Creating meaningful dialogues between formal and informal learners has been identified as a key challenge to collaboration (Jowers, Gaved, Elliott-Cirigottis, & Dallison, 2016), and will form the focus of the ongoing activities in the FabLab.

6 Conclusions

Through this project we have sought to respond to the question: ‘How can a FabLab empower marginalised communities?’ The case of FabLab La Campana in Monterrey, Mexico has shown that the co-design, co-creation and co-implementation of a Makerspace for, and with, this marginalised community has empowered its participants to engage in STEAM learning activities in an informal setting.

The seed of an idea of a FabLab was grown collaboratively. An equitable relationship between higher education institutions, third sector organisations and the marginalised community has been sustained through ongoing dialogue, regular events and frequent reporting of what has been achieved.

Participants co-created a safe space to encourage playful ideation and experimentation. Although situated in a high school, this is an informal learning space that also facilitates participation of vocational learners and makers from the larger community. Bringing making into community-created transition spaces through fabricated design interventions presented the scope of making to the community, which extends beyond the individual gain in skills and knowledge in a FabLab.

A key question is how can these change trajectories, already evident in some individual participants through the FabLab co-creation process, help to create a pathway for empowerment of the larger community? The potential impact of the empowerment of community through makerspaces is the access to informal education and to the high-skilled labour market and opportunities of entrepreneurship, which is usually denied to underprivileged communities. The reflection on learning through making and the sharing of

these experiences are areas that need ongoing investigation and support in order to empower the FabLab users and wider community.

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Crowdfunding for Design Entrepreneurship and Co-Creation

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Reward-based crowdfunding has become an effective method for designers to realize their product concepts and to promote the phenomenon of design entrepreneurship. Beyond financial aid, crowdfunding platforms allow design entrepreneurs to broadly interact with a large number of people. This interaction serves as a learning process for them to practice co-creation activities with consumers and grow their businesses. This study explores the phenomenon of design entrepreneurship through crowdfunding, particularly how design entrepreneurs manage the new product development process in the crowdfunding context and co-create value with crowdfunding backers. We conducted a 2.5-year case studies, with five designer-led startups in Taiwan, to obtain holistic findings to understand how design entrepreneurs manage co-creation activities in the crowdfunding context. Findings of this study show that the design entrepreneurs adjusted the NPD activities to cope with the fundraising process. The crowdfunding experiences enabled them to learn how to conduct co-creation activities to grow their businesses. The co-creation can contribute to the entire NPD process, from ideation to post-launch. According to the data analysis, we elaborate the co-creation activities in three dimensions: co-creation form, engagement platform, and engaging actors. The co-creation activities at different stages of the NPD process were further discussed in this paper.

Keywords: reward-based crowdfunding; design entrepreneur; co-creation; new product development

1 Introduction

Crowdfunding offers an alternative and a democratic approach to fundraising by drawing on relatively small contributions from a large number of individuals on the Internet (Belleflamme, Lambert, & Schwienbacher, 2013; Silver, Berggren & Fili, 2016). Among various crowdfunding platforms, reward-based ones are the best received and have attracted designers to raise necessary funds for introducing their ideas to the market, enabling them to launch startups or to develop small ventures (Gerber, & Hui, 2013). In the past, designers rarely established their own firms and placed their design ideas into production and market because funds from venture capitalists and banks were usually unavailable in the early development phases of startups. Without these funds, design entrepreneurs would face pressure due to funding gaps (Robb & Robinson, 2014). Thus, reward-based crowdfunding

has become an effective method for designers to realize their product concepts and to promote the phenomenon of design entrepreneurship.

In addition to financial aspects, crowdfunding allows project creators to reach a large number of individuals and receive inputs from potential consumers that can support in decision-making. Viotto da Cruz (2018) argued that crowdfunding serves as an informational mechanism, which provides a valuable source of information on the interest of potential consumers about the project. Information such as the number of project investors (backers) and how much each backer values the project alleviates part of the uncertainty prior to a new product's release in the market. Furthermore, entrepreneurs can receive feedback through suggestions, questions, and opinions that potential consumers leave on the campaign page during the product development process. The value of crowdfunding extends beyond the funds raised. Crowdfunding backers who invest on a project can become a community of active customers that provide external knowledge and boost the project. Designers usually initiate their crowdfunding campaigns in the early new product development (NPD) process. Therefore, they can involve customers (backers) in the product development through crowdfunding. The inputs from customers are a valuable reference that assists designers in adjusting their ideas to meet market needs and in enhancing the product performance.

Web-based platforms have considerably lowered the barrier for consumers to express their opinions and contribute to the improvement of new products. In the Web 2.0 context, consumers are no longer merely passive recipients, rather they are taking an increasingly active role in the NPD process to co-create value with companies (Berthon, Pitt, McCarthy, & Kates, 2007). The integration of consumers as external sources of knowledge is an essential concept of open innovation (Chesbrough, 2003). The knowledge offered by external actors assists nascent entrepreneurs to adjust new products to the external environment, which embodies the paradigm of open innovation (Mollick, 2016; Stanko & Henard, 2016). The shift from simply exploiting customer knowledge to co-creating value with customers has been a distinct culture in reward-based crowdfunding (Sawhney & Prandelli, 2000; Hanna, Rohm, & Crittenden, 2011).

Crowdfunding entrepreneurs benefit from the received funds and also obtain access to a large number of potential customers who are willing to be involved in NPD (Tung & Liu, 2018). Web-based platforms allow entrepreneurs to broadly interact with a large number of people. This interaction serves as a learning process for crowdfunding entrepreneurs to practice co-creation activities with consumers and grow their businesses. Considering that many designers in Taiwan start or grow their businesses through reward-based crowdfunding, their experiences can shed light on the effect of crowdfunding on design entrepreneurship. This study explores the phenomenon of design entrepreneurship through crowdfunding, particularly how design entrepreneurs manage the NPD process through crowdfunding and co-create value with crowdfunding backers. Although interest in crowdfunding research has increased, few studies have focused on co-creation by design entrepreneurs in the crowdfunding context. Because research in this design field is young and fragmented, we conducted 2.5-year case studies to obtain holistic findings regarding design entrepreneurship and co-creation value in the crowdfunding context.

2 Literature Review

2.1 Crowdfunding and Open Innovation

The concept of crowdfunding originated from crowdsourcing, which is the practice of obtaining information, ideas, or support in accomplishing certain tasks from a large number of people, especially those in the online community (Belleflamme, Lambert, & Schwienbacher, 2014; Martinez, 2017). Crowdfunding involves a collective effort from the "crowd" to raise funds online for a new project. This paper focuses on reward-based crowdfunding, in which backers are motivated by what they receive at the end of the project in return for their investment. Many entrepreneurs and fledging startups gravitate toward reward-based crowdfunding and utilize it as a pre-order platform to materialize their product concepts and launch their businesses. The mechanism of crowdfunding benefits from the collaborative nature of humans (McAfee, 2010). Crowdfunding entrepreneurs can connect, communicate, and collaborate with a large number of backers. Backers who provide feedback and ideas potentially assist entrepreneurs in improving initial ideas as products progress to market launch. The injection of a large amount of external knowledge contributes to NPD. Thus, crowdfunding can be seen as a manifestation of an open innovation paradigm in which the "crowd" contributes significantly to knowledge creation in addition to their financial contributions (Lewis-Kraus, 2015).

Innovation performance is related mainly to internal capabilities and organizational linkages with external entities (Piller, Vossen, & Ihl, 2011). Open innovation combining internal with external resources is an approach to boost innovation culture within a company. Despite increasing interest in open innovation, few studies have paid attention to startups and SMEs (small and medium-sized enterprises) because the implementation and management of open innovation can be overwhelming for small firms (Bogers et al., 2017; Brunswicker & Van de Vrande, 2014). Furthermore, due to a lack of internal resources, small firms depend on open innovation more than big companies do for acquiring knowledge, ideas, and relationships from external actors. With this consideration, crowdfunding allows small firms to retrieve knowledge through interaction with backers and obtain insights for enhancing market performance. Crowdfunding entrepreneurs can access individuals outside their firms and integrate them as external sources of knowledge. Regarding crowdfunding as a platform for entrepreneurs to connect with external entities, collaboration with external actors helps entrepreneurs to sensitize themselves toward open innovation practices. Attention should be paid to how entrepreneurs practice open innovation in the crowdfunding context to more thoroughly understand the effects of crowdfunding on entrepreneurship.

2.2 Customer Co-creation in the Crowdfunding Context

Co-creation can be viewed as a particular form of open innovation (Barczak, 2012). Prahalad and Ramaswamy (2004) advocated co-creation experience and stated that firms can co-create unique value with customers to unlock new sources of competitive advantage. Customer co-creation has been acknowledged to contribute to the early NPD stage, where customers contribute novel ideas, select which specific ideas should be pursued, or both (Kahn, 2005). Internet-based infrastructure has lowered the barriers for consumers to participate in the NPD process and allows them to play various roles, such as co-innovators, co-ideators, co-producers, co-designers, co-developers, and co-promoters (Agrawal & Rahman, 2015). The forms of customer co-creation can be widened through the involvement of diverse online and offline platforms (Frow et al., 2015). Focusing on music and film projects on Spain's crowdfunding platforms, Quero, Ventura, and Kelleher (2017) identified that backers contribute to projects in several ways, including co-ideation, co-investment, co-

testing and co-launch, co-valuation of ideas, co-consumption, and co-design. Driven by user-centered design philosophy, designers are trained to use approaches such as observation and interviews to obtain insights of users for defining the product based on what they need. The participatory approach advocates the collective creativity of designers and users working together in the design development process (Sanders & Stappers, 2008). Crowdfunding offers design entrepreneurs a platform to collaborate with potential users in NPD process, which increases the odds of product success. To assist designers in identifying opportunities for co-creation through crowdfunding, this study aims to understand how design entrepreneurs perform co-creation in the crowdfunding context to start or grow a sustainable business.

3 Method

This study aims to understand the impact of crowdfunding on design entrepreneurship. It particularly focuses on the co-creation value provided by backers in the NPD process through crowdfunding. Due to the limited research on the aforementioned topic, this exploratory study adopted a qualitative approach involving multiple case studies to obtain information regarding the issue. Interviews were conducted with crowdfunding entrepreneurs who could offer real-time accounts and retrospective views on the phenomenon of interest. The qualitative data from design entrepreneurs who initiated crowdfunding campaigns can provide insights into how the existence of crowdfunding promotes designers to turn into design entrepreneurs and co-create value with backers in the NPD process.

3.1 Selection of Cases

The cases considered in this research were selected according to the crowdfunding experiences of design entrepreneurs. The criteria for identifying suitable cases for this research were as follows: (a) The crowdfunding project was created by a designer-led firm, (b) the crowdfunding project had met its objective in terms of finance and would subsequently be realized.; (c) the crowdfunding entrepreneur had developed products through funded campaigns; and (d) the entrepreneur was planning to initiate another crowdfunding project in the near future. These criteria allow researchers to collect comprehensive data of the entire NPD process from ideation to post-launch. Therefore, we first searched for crowdfunding campaigns initiated by design entrepreneurs mainly on the Taiwanese crowdfunding platforms, flying V and ZecZec, and the US crowdfunding platforms ,Kickstarter and Indigogo. Five designer-led firms that developed different products, including 3D printers, watches, stationery, mobile phone accessories, and novel wallets, met the criteria and agreed to participate in the research. Table 1 provides details of the participating firms, including details of their crowdfunding projects, platforms they have launched on, and the year of the first project.

Table 1 Profile of Firms participating in this study

Firms	Crowdfunding Project	Platforms	Year of the 1st project
A	3D printers	ZecZec, Makuake	2013
B	watches	ZecZec, Kickstarter	2015
C	stationery	ZecZec, Kickstarter	2014
D	mobile phone accessories	ZecZec, Flying V, Kickstarter	2013
E	novel wallets	Flying V, Kickstarter	2014

3.2 Data collection

The primary data were collected through in-depth interviews conducted in two rounds within 2.5 years. In-depth and long-term case studies allowed us to observe the effects of crowdfunding on the design entrepreneurial process and obtain sufficient data to strengthen the research findings and interpretations. The first interview was conducted during January–May 2016, and the second interview was conducted during December 2017–April 2018. An artifact-based interview method was adopted for the research. During the interview, we provided cue cards containing text related to NPD activities, which aided interviewees in recalling their experiences. The interviewees were asked to use the cue cards to illustrate how they planned NPD activities and the crowdfunding process, as displayed in Figure 1. The interviewees were then provided a semi-structured questionnaire that addressed the following topics: (a) the company's NPD process and their plans to run a crowdfunding campaign, (b) co-creation activities in each stage of the NPD process, (c) outcomes of co-creation in the crowdfunding context, (d) the challenges involved, and (e) questions about the overall results.

All the interviews were conducted face-to-face, recorded, transcribed, and sent to the participants for their comments and approval. The secondary data covered media documentation, publicly available registers, and company social media, which ensured data triangulation through multiple sources of evidence.

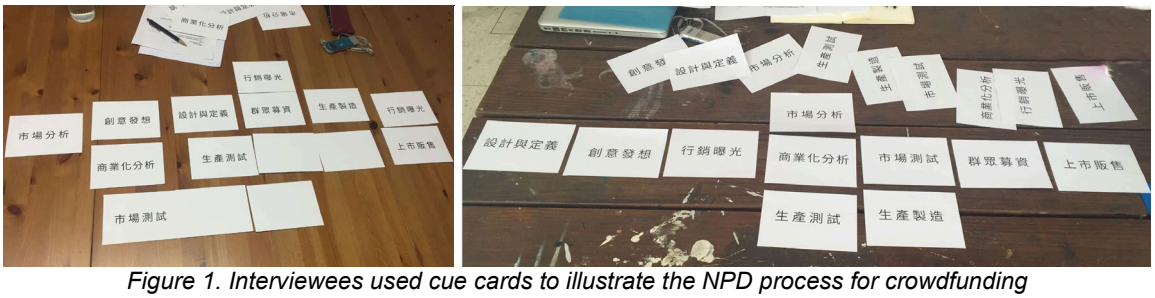


Figure 1. Interviewees used cue cards to illustrate the NPD process for crowdfunding

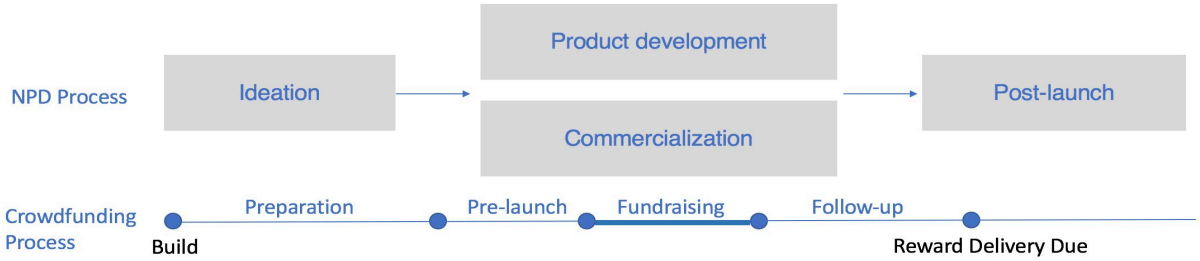
3.3 Data Analysis

After completing the interview transcriptions, data analysis was performed according to the principles of grounded theory methodology. We read the content collected for each case and analysed the data. Because the data was collected from multiple sources, data triangulation allowed the facts regarding each design entrepreneur to be validated. The data were encoded and categorized to form conceptual and expressive groupings. We then interpreted the data according to the research objectives. After performing profound analysis of each case individually, cross-case analysis was completed to identify patterns in the stories and obtain insights regarding how the design entrepreneurs adjusted the NPD process to crowdfunding and conducted customer co-creation through the NPD process. Insights triangulation among researchers was used throughout the data analysis process to ensure the reliability and objectivity of the findings.

4 Results

According to the research results, the design entrepreneurs adjusted the NPD activities to cope with the fundraising process, as displayed in Figure 2. The design entrepreneurs pitched new products before proceeding to full production and simultaneously worked on product development along with commercialization. Research indicated that co-creation in reward-based crowdfunding typically contributes to the late phases of the product development process (Lipusch, Dellermann, Oeste-Reiß, & Ebel, 2018). In this 2.5-year

study, our interviewees noted that they extended co-creation practices in the entire NPD process after initiating the first crowdfunding project. The crowdfunding experiences enabled them to learn how to conduct co-creation activities to grow their businesses. According to the data analysis, we elaborate the co-creation activities in three dimensions: co-creation form, engagement platform, and engaging actor. The co-creation activities at different stages of the NPD process are further discussed below.



	ideation	Product development	Commercialization	Post launch
Co-creation Forms	Co-conception of idea Co-evaluation Co-testing Co-meaning	co-evaluation co-developer co-testing co-endorsement	co-promotion co-evaluation co-pricing Co-consumption	co-experience co-promotion
Engagement platforms	Social media Prototype	Social media Crowdfunding platform Prototype		Social media
Engaging actors	Community members	Community members Crowdfunding backers Potential backers		Crowdfunding backers Consumers

Figure 2. Co-creation activities in the NPD process within crowdfunding context

4.1 Co-creation in the Ideation stage

After each crowdfunding project, the interviewees gradually established their customer community and learned to engage their community members in NPD process. Most crowdfunding backers were committed costumers who were recognized as an essential part of the formation of the "community of active users." Therefore, the customer community comprised primarily of crowdfunding backers, representing an important group of co-creation partners. Engaging consumers in the ideation stage can contribute to the success of new products. The findings of this study indicate that the community members participated in the following co-creation activities: co-conception of ideas, co-evaluation, co-testing, and co-meaning. The engagement platforms involved social media and prototypes.

The interviewees established their own online communities on several social channels to forge strong relationships. Their community members were eager to provide feedback and suggestions regarding their usage experience, which helped spur discussions among community members. The contents generated by online communities offered a wealth of information about customer requirements and desires. The interviewees mentioned that they could tap into knowledge and ideas from their community members and identify new opportunities. The founder of Case B admitted that he had no idea regarding new products after the first campaign (watch). However, he received many requests and suggestions from backers that motivated him to expand the product line and develop mechanic watches. From discussions with the community members, he gained the support and confidence to design

new watches in various modes and develop mechanic watch through another crowdfunding campaign, which was more successful than the first campaign. Case D originally focused on protective cases of mobile phone, which allowed users to use their mobile phone as a camera when taking a picture. Many crowdfunding backers asked them to develop accessories such as compatible lenses to improve usage experience. To satisfy various user requirements, Case D developed new product lines, a new lens collection, bags, and accessories for enriching the product portfolio and strengthening the brand image. The lens collection ranging from regular lens to lenses with specific functions became a major product line.

In addition to gathering information from online communities, the interviewees engaged their community members in co-evaluation activities by sharing the concept with them and actively seeking their feedback. For example, Case B and E presented several new concepts to their online community members and asked them to cast votes or leave comments. The results allowed the entrepreneurs to understand consumer preference and served as a reference for making decisions. Furthermore, entrepreneurs can involve customers as co-testers by asking them to test a new prototype. Case A sent their core customers new modules or prototypes to obtain their testing feedback. The founder of Case A noted that they had developed a co-creation relationship with the backers since the first crowdfunding campaign in 2013. The backers that supported their first campaign were innovators or 3D printer experts. Their opinions were valuable and helpful for the firm to enhance and upgrade the features and attributes of new products.

The relationship with crowdfunding backers can be maintained even after crowdfunding. Social media provide a cost-effective platform for consumer–firm and consumer–consumer interactions and have drastically changed the value co-creation landscape. Involving consumers in the early stages of the NPD can enable entrepreneurs to be familiar with potential consumers for generating new concepts aligning with their needs or desires.

4.2 Co-creation in Product-Development stage

Activities during the product development stage involve design verification, final revision, and manufacturing. Customer co-creation helps in the calibration and refining of new products. The main actors engaging in co-creation activities include community members, crowdfunding backers, and potential customers, who contribute to product development through co-evaluation, co-development, co-testing, and co-endorsement. Engagement platforms include social media, crowdfunding platforms, physical events, and prototype products.

Before launching a crowdfunding project, the interviewees noted that they would seek inputs from potential consumers for design calibration, prioritization of product features, and validation of some details of the new product. They shared the product concept on social media to obtain feedback from their community members or used questionnaires to ask potential consumers to prioritize or evaluate the features for the new product. These activities allowed entrepreneurs to understand how consumers perceived the new product and how to refine the new offering.

During fundraising, crowdfunding creators obtain ongoing and timely feedback from the crowd interested in their projects. Interviewees stated that this allows them to listen to customer voices and improve the initial idea to meet market acceptability. For example, Case E’s wallet came with a magnetic design that allowed users to place the wallet on any metal board and easy pick up. However, many people were concerned that the magnetic

design might demagnetize credit cards. Although Case E had tested the function and knew that the magnet did not result in such a problem, they finally decided to remove the magnetic function to mitigate the perceived risk. In addition to the feedback from Internet-based platforms, the interviewees also hosted offline events to showcase their project to invited backers or potential backers so that they could experience or test the prototype product in person. The participants in these physical events served as co-testers for using or experiencing the prototype products and providing feedback on the new offerings. Design entrepreneurs also used the opportunity to observe how people used or reacted to the new products. For example, the pen “Slide” designed by Case C creates a subtle hand feel to enrich user experience. During crowdfunding, Case C ran a couple of trial events to observe how people used and judged the prototype. They used this information to refine certain details regarding the final product to promote a better user experience.

An important contribution made by crowdfunding backers is that they commit to future consumption, suggesting that the product is endorsed by a group of consumers. This endorsement provides small firms the credibility that helps them negotiate with factories and move the idea to production. Design entrepreneurs lacking experience and reputation usually have difficulties in outsourcing external manufacturers. The success of crowdfunding can increase the firm’s reputation and increase the likelihood of success in negotiating with external resources. For example, Case A did not meet the minimum order quantity when they came to the manufacturer; however, the success of crowdfunding signalled the project’s potential and convinced the manufacturer to produce their machine. The number of backers and funds raised in crowdfunding become a support to entrepreneurs for seeking supply chain providers.

4.3 Co-creation in Commercialization Stage

Commercialization activities focus on the marketing and selling of a product in terms of packaging, promotion, branding, and pricing to appeal to customers and entice them to make a purchase. Thus, running a crowdfunding campaign actually involves working on commercialization activities. To achieve success in a crowdfunding campaign, entrepreneurs learn how to reach out to a wide range of potential consumers and practice how to communicate with their potential customers. They engage prospective backers in co-creation activities, such as co-promotion, co-evaluation, and co-pricing, thorough social media and crowdfunding platforms.

Commercialization activities are started in the preparation stage of crowdfunding. Design entrepreneurs use various methods to seek the inputs of community members as co-evaluators for deciding marketing strategies or the price of new products. For example, design entrepreneurs use questionnaires to ask target audiences to prioritize the product features for deciding promotion strategies. The founder of Case B used advertisements on social media to understand target audiences’ responses to their watches with different prices and specifications. The results of advertisement testing acted as a reference for them to set the price.

During the funding process, design entrepreneurs have to communicate with prospective consumers and respond to their comments and suggestions. The practice of communication with a large number of consumers enables entrepreneurs to learn how to market their product. The founder of Case D pointed out that their first crowdfunding project taught them to verify the market opportunity and experiment marketing strategies. They adjusted the marketing strategy so that consumers could perceive the value of their product. The founder stated that:

"*...through running the crowdfunding project, we have learned how to communicate with consumers. We believed that our descriptions were clear enough for consumers. However, consumers did not understand them. We adjusted how we communicate with consumers according to questions and comments raised during crowdfunding.*"

The feedback from the crowd guides design entrepreneurs to judge their products from an audience or user point of view and increase the effectiveness of marketing communications. Crowdfunding provides nascent entrepreneurs a marketing communication tool for achieving effective marketing communication.

4.4 Co-creation in Post-Launch Stage

In terms of customer co-creation, post-launch activities include nurturing the community, continuously updating information, and maintaining customer relationships. Macht (2014) suggested that crowdfunding is the beginning of developing a long-term relationship with backers. The interviewees indicated that the relationship with backers was continuous rather than a one-time trading relationship. Each crowdfunding campaign can grow its consumer community, and the advent of social media has enabled design entrepreneurs to maintain lasting relationships with their backers. Community members contribute to co-creation activities such as co-experience and co-promotion in the post-launch stage.

Case A built their communities on various social media for bringing its owners together to discuss, support, and share. According to the feedback from backers' usage experiences, Case A learned to absorb the collected information and managed to keep improving their 3D printer. The customer experiences (whether favorable or otherwise) assisted them to continue improving the existing products for achieving customer satisfaction.

The founder of Case E mentioned that "*The first generation product on Kickstarter received a lot of feedback and complaints. To be better, we developed the second generation that was completely aimed at the improvement of the previous generation. And it worked, the negative reviews for the second version were much less*." In addition to the discussion on the online community, backers would become product ambassadors and promote the product to their own community if they were satisfied with the crowdfunded product. Considering that many backers are lead users and early adopters, their endorsement assists in word-of-mouth enhancing of the product awareness.

5 Conclusion

This research explores how design entrepreneurs co-create with customers in the crowdfunding context. This 2.5-year study aims to understand how design entrepreneurs manage co-creation activities in the entire NPD process and how this customer-centric process occurs in the design entrepreneurial process. For nascent entrepreneurs, crowdfunding is one of the channels to directly reach potential customers and know their customers better. The engaged users become valuable co-creation partners and have a positive impact on the entrepreneurial development of designers. Currently, in the increasingly complex and knowledge-intensive world, customer co-creation helps companies to cope with uncertain changes in the market demand. According to this study, entrepreneurs who want to maintain their firm's growth must focus on crowdfunding not merely for the raised funds, but rather to develop a lasting and stable relationship with backers. Online platforms and tools have revolutionized the interaction between companies and their customers, where companies and customers can co-create value in a comprehensive and an efficient manner. The future competitive advantage of entrepreneurs

would rely on their ability to maintain an active community and engage the community in co-creation activities that revitalize innovation. The involvement of consumers in NPD processes enables design entrepreneurs to access external knowledge for creating and developing their firms. As consumers evolve into multiple co-creation roles in NPD processes, design entrepreneurs should seek methods of working with this outside resource effectively and integrating consumer-centered approaches to innovate their offerings.

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Cultivating Foresight Competencies in Design Education

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The increasing pace of industry necessitates that faculty critically consider the future of design in higher education. Fueling industry innovation, is an increasing demand for trend forecasting practices. So, how can design students be exposed to and participate in the future research practices of their industry, today? During Summer 2018, qualitative interviews were conducted with 13 expert Trend Forecasters across various sectors on the present and projected future of Trend Forecasting. These insights were used to rapidly innovate new pedagogical tools and approaches over Fall 2018 which were then tested across two trend forecasting courses during the Spring 2019 semester. Outcomes from this rapid test and learn approach show that interdisciplinary collaboration and strategic translation of trend insight is critical to set the stage for the breakthrough innovations of tomorrow. Going forward, all design students should attain competency in Trend Forecasting to lead the next design revolution.

Keywords: trend forecasting, rapid innovation, design pedagogy

1 Forecasting at a Crossroads

Design innovation is not optional. As our world continues to evolve, the need for design higher education to respond is urgent, especially in understanding the changing human condition, where deep intercultural knowledge and creating for an increasingly interconnected world is mandatory (Penprase, 2018). As pressingly, increased global disruption and uncertainty fuel a growing demand for designers who can create for a disrupted future, emergent consumer groups, or alternate future scenarios (Johansen & Euchner, 2013). This points toward a design revolution where connected, interdisciplinary, and agile innovations are critically necessary. As design educators, we are responsible for preparing our students for the future every day in our classrooms, which requires design education as a whole to adapt for the next design revolution.

Looking deeper at the practice of design innovation, in order to understand and fuel innovation, designers must be introduced to Trend Forecasting in the classroom. To specify, Trend Forecasting is defined as a strategic research practice that detects patterns or shifts in attitudes, mindsets or lifestyle options that run against current thinking or how people normally behave, live, dress, communicate or trade (Raymond, 2010).

Trend Forecasting has been traditionally used to inspire design novelty and advance aesthetic execution with a long history within the field of fashion design (Bloomsbury, Blaszcyk, R. L., & Wubs, B., 2018). As such, when considering the impact of trends, and the practice of Trend Forecasting, one must consider the history of the practice in design in tandem with its future evolution. Today, designers of all types use short-term trend forecasting to inform color, material, finish, function, and purpose decisions as well as macro-trends to connect future shifts with design strategy through forecasting approaches like scenario planning (Evans, 2004).

Despite an established connection to the design process, as a practice Trend Forecasting is often challenged as being "too fuzzy" or not easily translated to strategic product, service, or experience applications. While Trend Forecasting is often a part of in the inspiration phase in the Design Thinking process, too often this powerful methodology for futures thinking is underutilized. Specifically, Trend Forecasting is not consistently conducted prior to design development, nor utilized to provide future context for design development, and in some cases Trend Forecasting is absent entirely in industry innovation practices.

Once the sole purview of fashion designers, trends have become commonplace in every creative field (Tetlock & Gardner, 2015). This notion is also supported by preliminary analysis of further literature review and qualitative interviews with design innovation experts. Today, everyone with an internet connection can now feel capable of approximating the next "big" design movement or cultural trend. Li Edelkoort explains in the *Anti-Fashion Manifesto* that from shopper and retail trends to socio-cultural and technology trends - with a click of a mouse, industry professionals and design students are inundated with a landslide of facsimile reports on "what's next" (Edelkoort, 2015). Hence, the profession of Trend Forecasting needs to to evolve at pace with the next design revolution.

This puts the profession of Trend Forecasting at a crossroads - which creates an ideal opportunity for it to become a foundational industry practice and for design educators to integrate insights from industry evolution into their own pedagogical core.

The Myron E. Ullman Jr. School of Design at the University of Cincinnati has a vested interest in cultivating and educating design students in futures-based research. Our school also has a history in and continues to prioritize resources toward the development of new curricula within this area of study. Beyond our 35-yearlong pedagogical history, Trend Forecasting is in high demand with our university employer partners. With 150 years of integrating classroom theory and industry practice through our university's Co-Operative Education model, our industry partners seek our students for internships specifically for Trend Forecasting roles and many of our graduates pursue careers as professional Trend Forecasters.

To inform and align curricular improvements with the evolution of Trend Forecasting, data was gathered through interviews with industry experts and practicing program alumni on the present and projected future of Trend Forecasting. The opportunity to revise curricula, and implement revisions quickly, is rare. Given this reality, the approach to developing the research foundation, strategic recommendations, and pilot activities were structured, much like a trend forecast, by documenting how we intended to shift from our present curricular context into the future.

2 The Future of Trend Forecasting

Qualitative research was conducted through interviews with 13 international and domestic expert practitioners of Trend Forecasting. Interviews were semi-structured with a common question set, and all interviews were held in person or via phone. Topic areas included the practice of the Trend Forecasting methodology, its use, and application. Additionally, broader belief and value-based questioning explored how firms are using the methodology, as well as the participants' underlying feelings on the state of the Trend Forecasting profession. Interview participants represented domestic and international trend, strategy, and design firms, including one global corporation. Participants were selected based upon their educational background (alumni as well as non-alumni), years of experience, and job title (ranging from entry-level to senior management) to ensure a cross-section of interviews with day-to-day practitioners as well as company leadership. Data was transcripted into a master response matrix using a digital question-and-answer form developed by the interviewers to collect and uniformly catalog responses. Thematic analysis was used to code recurring themes and concepts once all data had been gathered, and then macro insights were extracted using displayed thinking methods.

Interviewees of all levels of experience reiterated the three critical insights on the future of Trend Forecasting: interdisciplinary teams, applied research, collaborative innovation practices.

These insights aligned with trends in the broader design industry, which indicated that recommended changes would be viable across all design disciplines. The aggregate insights were then used as a strategic framework for course content revision and student activities in the two studied trend forecasting courses *(See 3 Methodology for Curricular Improvement - Course A and Course B)*.

2.1 The Future of Trend Forecasting: Insight One

Stated across all interviews, innovation teams at firms are increasingly interdisciplinary, with practitioners of Trend Forecasting holding creative backgrounds beyond fashion design. The success of interdisciplinary teams, or group-based trend research approaches, is in line with Tetlock and Gardner's conclusions presented in *Super Forecasters* which supports this insight and gives good confidence that this insight is critical to consider in all forthcoming revisions.

Innovation teams use a variety of naming conventions for their practice units, however, most do not use the word "trend" in their unit name and instead use terms like "strategy," "insight", or "foresight". When probed on this, participants expressed a need to educate external clients and/or internal partners on the meaning of the term "trend" and that it extends beyond style and apparel to social movements, economic shifts, technological innovations, as well as political and environmental policy. The observation that language and articulation of trends plays a key role in successful understanding of research, and reasoning is critical when working with disciplines outside of design. This implicates that if the Trend Forecasting methodology were to be expanded across our school there should be a common language, or guide, that all participants and instructors align upon.

This leads to the first insight into changing the present Trend Forecasting curricula:

Trend Forecasting courses should be interdisciplinary and available to all design majors with a common methodological core and lexicon.

2.2 The Future of Trend Forecasting: Insight Two

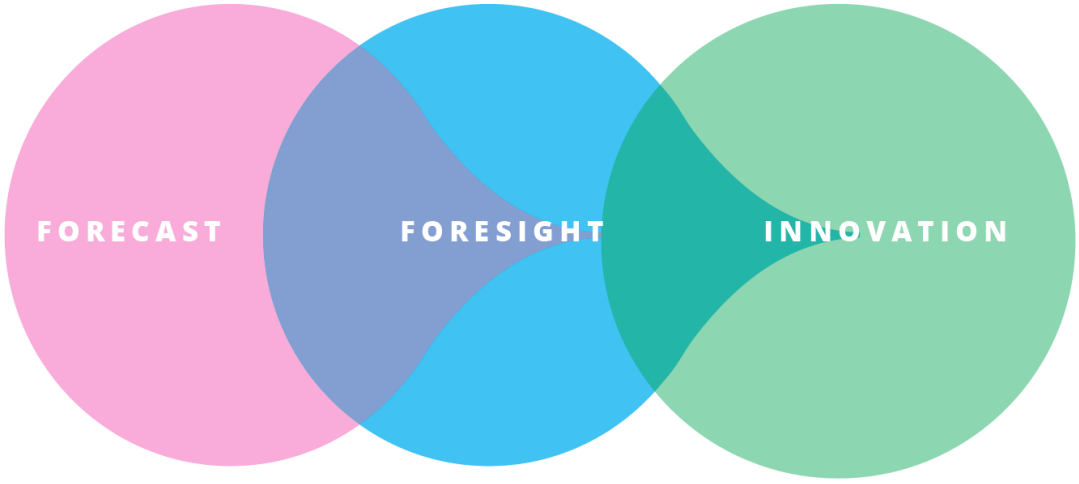
Emerging from the thematic analysis, the role of the professional forecaster is expanding from predicting future trends, to active storytelling and integration into innovation efforts, since practices, terminology, team organization, and use of trend forecasts in industry have shifted. Even terminology used to express the role of Trend Forecasting in industry focused on active statements: “implicate”, “activate”, “translate”, “innovate”. In line with Raymond’s handbook, firms and participants still use Trend Forecasting and trend reporting to inspire, or stimulate, design ideation. However, all participants expressed frustration with the translation and application of trend data to design concepts. As mentioned above, many teams include design researchers. These individuals, in particular, are often required to lead design ideation sessions that intend to translate trends into the development of concepts, or to create suggested design applications for use in a subsequent design brief. The “gap” between articulation and translation was a recurring theme. The forecasters, who are subject matter experts, tend to “see” the impacts of the forecast to all aspects of a given category or landscape at a highly granular level. The amount of education and energy required in evangelizing those impacts to their audience was noted as extremely high in some cases. The gap between forecast and translation is a significant hurdle in the use of trend forecasts. In some environments, the sharing of a forecast with a design team is colloquially called “throwing it over the fence”, which underscores the divide between those who are researching the future and those who must do something with that knowledge. This suggests a solution would be to train all designers in trend forecasting so that translation is accurate and aligned with trend evolution.

This leads to the second insight in changing the present Trend Forecasting curricula:

Trend Forecasting no longer stops at the creation of a trend forecast. Trend Forecasting methodology must evolve to include phases devoted to active translation and design application of foresight.

2.3 The Future of Trend Forecasting: Insight Three

The interviews revealed that the method of applying trend forecasts is shifting as well. Teams were challenged to maintain integrity in trend translation and application by monodirectional trend presentations that did not use forecasts as a catalyst for collaboration. Across all interviews, industry stakeholders repeatedly acknowledged the role foresight plays in anticipating and acting for future scenarios as a team. The term foresight can be understood as insights from the future and was often a synonym for summarized trend reports, or used to qualify and validate trend forecasts. Foresight appears to be emerging as a more unified representation of the internalized knowledge gained through trend forecasting, which enabled trend forecasters and designers to more effectively collaborate on design applications. Deeper analysis of this particular shift in Trend Forecasting practice, outlines an interconnected relationship between trend forecasts, resulting foresight, and foresight translation. As illustrated by *Figure 1* below, foresight is the essence, or DNA, of a forecast that enables effective translation to design innovations by practitioners. This mirrors the adaptive, interconnected requirements of the next design revolution and could be considered as a guide for structuring course activities.



Flannery, 2019

Figure 1

This leads to the third insight into changing the present Trend Forecasting curricula:

Trend Forecasting courses should be treated as design studios, as opposed to lectures, to better reflect the collaborative requirements of this practice in industry.

This research suggests in order to adequately prepare students for the future of Trend Forecasting, as design educators, we must adapt and focus on curricular interventions that are interdisciplinary, collaborative, and focused on trend translation. Directly following research and analysis, near and far-term interventions were mapped for a pilot that would integrate these insights and aim to prepare our students for futures in design innovation. Taking advantage of our current curricular map where two Trend Forecasting courses are taught during Spring semester 2019 - Trend Course A and Trend Course B - a pilot study was planned and implimented across both courses.

3 Methodology for Curricular Improvement

From the aggregate insights from our interviews, opportunities to actively develop new pedagogical tools were identified and approaches to test findings were mapped across both courses. Activities included revising the course guidebook, adding guided trend identification training, developing a forecast worksheet, bibliography worksheet, and trend articulation worksheet, as well as ideation modules. The guidebook was published across both courses for continuity and to serve as a common methodological framework. Furthermore, the additional video modules which covered general principles were created in order to free up class time for reflection and active learning exercises. The authors worked together across these courses to deploy the insights and iteratively developed tools through bi-monthly meetings to discuss feedback and adapt course content as needed.

Additional constants across both courses were that the syllabi were structured in the exact same way, utilizing a sprint-based approach that divided the semester into four four-week modules that set the foundation of the revised methodology and guided students in the development of near term forecasts (year 2025), far term forecasts (year 2030), foresight implications, and forecast translations per *Figure 1* above. With attention to general best

practices for active learning and flipped classroom methods (Gilboy, Heinerichs, & Pazzaglia, 2015), course content was updated to include a variety of multimedia content, such as aforementioned guided video lectures and in-class reflection, to enhance student attention to course content and retention of knowledge.

Details of Courses:

Duration/Schedule of Class:

- Course A - met twice a week for 1.3 hours
- Course B - met once a week for 3 hours

Age of students:

- Course A - students range from third year to fifth year (senior level)
- Course B - all third year students in the fashion design program

Major

- Course A - students were from majors across business, engineering and design, art, architecture and planning
- Course B - all students were from the fashion design program

Size of class

- Course A - 17 students
- Course B - 48 students

4 Pilot Outcomes

Relative to the three driving insights – interdisciplinary teams, applied research, collaborative innovation practices – the difference in the two courses studied were in their interdisciplinary enrollment. Both courses were adapted to focus on activities and course content that leveraged applied research and collaborative innovation practices, however, only Course A used interdisciplinary teams. Given the structure of the program, school, and college curricula, this variable was helpful to analyze to understand if going forward systemic enrollment practices and course offerings for Trend Forecasting courses should be considered for change to better align with industry practice. Overall in both courses students successfully completed all course objectives which included demonstration of understanding the Trend Forecasting methodology as currently practiced in industry, accuracy in practicing the methodology for development of near and far-term forecasts, and application of the methodology to an innovation-focused design challenge. In analyzing the results of this pilot at the close of the course, there were challenges unique to each course that need to be addressed in future semesters:

Course A:

- More course time needed to be devoted to teach and apply human-centered analysis to identify the relationship between a trend and impacts on future consumer behavior for the purposes of innovation-focused design challenge.
- Students needed more guidance and support during translation and ideation activities; the interdisciplinary nature of the students could be one of the attributing

factors in that not all students enrolled had prior design thinking or design ideation related courses.

- Qualitatively, students rated this course as very interesting and engaging. They also stated they “wished they could enroll in this class earlier in their program” and that there were more Trend Forecasting courses available. This points to an opportunity to expand the offering of these courses and suggest a systematic change to the way this course is offered and enrollment is enabled.

Interdisciplinary groups were able to effectively interpret the impact Trend Forecasting has on their field of study. Their resulting trends were successfully expressed using a range of both quantitative and qualitative data sources. In their innovation-focused design challenge, the interdisciplinary teams appeared better able to ideate a wider range of product, service, and experience concepts and also considered intellectual-property-focused partnerships (e.g. company A should collaborate with company B to create a new-to-market offering based on the combined IP of both entities). Though, as noted above the resulting ideations could have benefitted from more time to analyze trend impacts to adjust concepts to be more future-consumer relevant. Additionally, with a smaller cohort, the instructor was able to develop and distribute a printed compilation of the student’s far-term forecast to use as a text for the final weeks of the course which were focused on trend application and ideation. This document establishes the foundation for self-sustained library of student generated futures-research for reference, which will become standard practice in future courses.

Course B:

- The large quantity of students (48) restricted the level of discussion the instructor could have with the students. This dialogue is a critical component in teaching this course since the methodology emphasizes frequent analysis and synthesis. Therefore, more time was needed for the development and articulation of the near and far term trends. This also indicates a suggested change to the systematic offering and enrollment of this course at the School and College level.
- Similar to Course A, more time was needed than initially allotted to emphasize human-centered analysis and identifying the relationship between a trend and impacts on future consumer behavior for the purposes of innovation-focused design challenge.

Successful adaptations given the challenges of this course included:

- Due to the large quantity of students in Course B, and the importance of analysis and synthesis, the faculty secured a graduate assistant (who had previous training in trend forecasting) to support class activities and discussion. Furthermore, the faculty proactively involved industry practitioners in the classroom to provide feedback to the students’ work.
- By dividing the students into 5 large cohorts (approximately 9 students in each), mimicking a professional practice approach, students proved to successfully self-manage and work effectively together.
- A part of the trend research process requires students to engage in qualitative research (observation / interviews). Though both courses could not be

interdisciplinary, efforts were made to give students in Course B the opportunity to interact with other disciplines through an interview exercise with anthropology students.

5 Conclusions

This research yielded valuable insights into changes in the design industry specific to the future of the Trend Forecasting practices: a requisite for interdisciplinary teams, the increased requirements for applied research, a growing emphasis on collaborative innovation practices. Though focused for the purpose of this pilot, these insights can be extended to other design practices and researchers as well. Wherever possible, multiple points of view and expertise should be included in both research and innovation practices, research outcomes should be action-oriented, and opportunities for collaboration should be included throughout.

In this study, the research conducted with industry practitioners provided faculty with actionable insights to inform the design of the two upcoming trend courses. This afforded the opportunity to quickly implement insights into the curriculum through interdisciplinary collaboration, by focusing on multimedia activities around translation and application of trend forecasts, and also by teaching students to integrate trend foresight and innovation.

This approach allowed the program to quickly reflect current industry best practices in Trend Forecasting, enabling students to use the methodologies in class and in their upcoming work experiences. Our college is practice-based requiring mandatory work experience rotations, so this pilot was an exciting confirmation that connecting pedagogy and practice yields benefits not only to students practicing in industry, but in connecting industry insights into pedagogical improvements. Since language and articulation of trends plays a key role in successful understanding of research, faculty revised the course guidebook, and also developed common tools and materials to be utilized across the courses, with the aim of unifying pedagogical approaches in teaching Trend Forecasting. Language and articulation is presently a point of emphasis in our school's Trend Forecasting methodology, however, given the interdisciplinary nature of our school and the Trend Forecasting industry – and the need for a common language – further integration of this insight must be prioritized.

The revised Trend Forecasting curricula enhanced students' creative thinking skills, by teaching applied trend research practices so that they could communicate their research outcomes and the impact to their resulting design innovations, which better prepares them for practicing this methodology in industry. This model also enables students to apply their learning from the Trend Forecasting course to their other studios in a more industry relevant manner without allowing industry to overly drive curricular structure. Future research can be conducted to track how students use trend skills developed in subsequent courses and the impact this pilot had on attainment of Trend Forecasting roles in industry.

Outcomes of this research resulted in the creation of new competencies for the school: a new center and labs focused on strategic foresight, data visualization, and predictive analytics. This positions our school to expand Trend Forecasting beyond student engagement into faculty collaboration across the university, as well as industry partnerships.

Moving from the pilot to established curricula is fueled by the belief that all designers should attain competency in Trend Forecasting. Designers are often leaders of change and this methodology as a core to their process strengthens the contextual "why" behind their work.

Trend forecasting equips all students with a broader understanding of future socio-cultural constructs and their impacts. Creating for the world of tomorrow, instead of the world of today, is the future of design education.

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Cultural Integration: the Coupling Relationship between Design Revolution and "Blue Sea" Strategy of Innovation China

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ABSTRACT: Under the new situation, design not only has been seamlessly connected with high-tech industries such as health care, artificial intelligence, green materials but also closely linked with "soft science" such as cultural heritage and educational methods. It has changed from the "physical logic" focusing on physical shape, colour and material to the "non-physical logic" focusing on the "pivotal role" of design and problem-solving. Meanwhile, the innovation of China's "blue sea" strategy requires us to innovate in science and technology, culture, management, and other areas, so as to enhance our core competitiveness in the complex international situation. It can be seen that design revolution and China's innovation strategy need to carry out "element reconstruction" and "breakthrough" to traditional solidification factors in the fields of science, culture, and economy. The intersection between design revolution and China's innovation strategy has created a key coupling effect. Through describing the present situation of the reform in the field of design, and introducing the understanding of the three dimensions of China's innovation strategy, the inherent logic of the coupling between design revolution and China's innovation strategy is put forward. Furthermore, through the Malan-Lake project, the paper successfully describes the story of design "empowerment" and desert ecological optimization, which discusses the relationship between design revolution and China's innovation strategy from the perspective of empirical research. Finally, it points out the urgency of catalyzing design revolution to promote the construction of China's innovative country and the effectiveness of China's innovation strategy to inspire design revolution.

Keywords: cultural integration; coupling relationship; design revolution; innovating china; "blue sea" strategy

1 Introduction

Since entering the post-industrial society, what changes have taken place in design, what it should pay attention to, what its social essence is and other similar philosophical issues have gradually aroused the interest of scholars. For example, Martin (2007) put forward the characteristics of comprehensive design thinking; Lu and Liu (2017) indicate that a good design requires a good grasp of historical context and profound philosophical connotation, taking its essence and discarding dregs; Senge (2006) highlights the significance of systematic thinking in his Fifth Discipline and in his The Necessary Revolution connects "Brand New Thinking", "Triple Bottom Line" and the social "Bermuda" together. Xin (2016)

always underlines that design should assume its social responsibility and critically considers the existence and development of human society on a new scale. Thus, the design is trying to search for the best way of sustainable innovation and the new theoretical model of design, focusing on more opportunities to intervene in a wide range of social changes and unknown fields. Whether there is a challenge coming from new technology or complex society, design-driven innovation has become the key to redefining the next change.

On the other hand, the proposal of Innovation China Strategy also triggered a widespread discussion in the domestic industry. For example, Cao et al. (2018) briefly described China's medium-and-long-term science and technology planning and independent innovation strategy (2006—2012). In addition, the strategic adjustments that should be adopted for the challenges of China's science and technology system in the future were put forward. Fan (2018) discussed the development of global science and technology innovation and the innovation-driven strategic choice in China. He also pointed out that the strategy of innovation-driven development is a systematic project that necessarily speeding up the construction of an innovation-oriented country through deepening the reform of science and technology system, promoting the construction of innovation-oriented talents and so forth. Zhou (2017) analyzed the emphasis of American innovation strategy and Chinese innovation-driven development strategy. These scholars have interpreted the innovation strategy of China from the different perspectives and also mentioned that it needs fundamental changes in all aspects such as the fields of science, economy, the architecture of management and so on.

the design innovation and China's construction strategy produces a series of internal coupling relationships in its potential needs. The paper studies this relationship from the angle of interaction between Design Science and Innovation Strategy, which is a new topic in the research of national strategy under the background of design-driven reform and innovation-driven development.

2 The Status Quo of Design Reform

2.1 Evolution and deconstruction of design paradigm

Nussbaum (2005) pointed out that "Our societies and institutions no longer function properly in business, financial system, environment, health care and education with no moves. As a result, there is an urgent need for design reform and a new definition of design, which is where design works". In addition, just as Giddins (2000) describes in his book Visions of Jazz: The First Century, "when everything is predictable and lacking in excitement, jazz (design revolution) proclaims a kind of innovation, change and surprise, which is the urgent need of this stereotypical world. It will be a great medicine to wake up the world".

In response to Nussbaum's appeal, something has changed in design, which is shifting from the production of "posters and ovens" to the design of process, system, and organization; from focusing on the dimensions of "beautification", "functional realization" and other single "objects" to acting as a "hub and tie" and closely linking different industries such as education, health care, commerce and so forth to deal with many "wicked problem" (Buchanan, 1992) in society together under the view of diversification. For example, president of the Design Management Association of America Thomas Lockwood has teamed up with MIT and Harvard Business School to work on the project about "food chain systems, childhood obesity, and emergency medical assistance".

In recent years, a series of important academic conferences (table 1) have been held in China to discuss the design objects. The theme of it indicated that the Chinese design community has also given a new life to design—design must get rid of the old logic, acquire self-reform and construct a new framework and organization in order to make it possible to weave new methods, economies or technologies, truly adapting to complex challenges and abstract social propositions in their respective fields (Chen, 2010).

Table 1 the List of Top Design Academic Conference in China

Sponsor	Name	Time	Place	Subject
School of Design, Jiangnan University	International Conference on Redesign of Design Education	2012－2016	Wuxi, Jiangsu	Category, method and value; new fields, problems and countermeasures; philosophical concepts; new phenomenal bases: experience, strategy and health; well-designed education: experience, ability and ideal
Alliance of Technological and Organizational Transition Trends	TTF Forum and CMF International Carnival	2017.11	Shenzhen, Guangdong	Enterprise transformation and Organizational innovation
Cumulus Association	2018 Cumulus International Conference	2018.10	Wuxi, Jiangsu (secretariat: Helsinki, Finland)	Extensive transformation and design opportunities: discussing the state and trend of design in the transitional era, responding to common challenges in the context of globalization 3.0 and reflecting on the new functions of design
College of Design and Innovation, Tongji University	Second International Forum on Design Management and Innovation Strategy	2017.12	Shanghai	Innovation, Design, Education
IXDC	IXDC Annual Festival: The Ninth International Conference of Experience Design	2018.07	National Convention Center in Beijing	The construction of new framework of design experience: humanization, intelligence and platform
Art and Scientific Research Center, Tsinghua University	Tsinghua University, Art and Design Month	2017.11	Beijing	Social innovation design: design for community renewal

2.2 The upgrading of design education

The focus of industrial design has changed from a product's color, modeling and some other called "materialization" in the past to ethnographic research, interaction between product and human and attributes of design service that all are concerned with the product; the focus of digital media design has added "artificial intelligence, big data analysis, visualized research of information" and some other research hotspots to the production of animation lines, scenes, and characters that are all paid attention to before. What the environmental art design major originally focused on was the structure, modeling, lighting, comfort of living in the architecture, "resonance" between the beauty of architecture, while the focus extends to the ecological environment, natural climate, local customs, and other similar areas. Besides, in Paris DMI International Education Conference was held: "the ability to reinterpret the value of design and design relevant responsibilities in a specific organization and context". From "Design 1.0 to Design 3.0" (Shao & Wang, 2014), design objects are no longer limited to physical products; the scope and boundary of products are expanding (from material to non-material, from entity to fiction, from "device" to "content") (Xin & Cao, 2015); The intersection of design disciplines are becoming increasingly stronger.

2.3 The changes in the number and contribution of design talents

"Design creativity makes up 25% of the U.S. workforce." Hollowell Brian, who wrote McKinsey, and Claudia Joyce said in Business Review, and Richard Florida from the University of Toronto adjusted this figure to 30%. Both numbers have been through dramatic changes compared to the previous occupancy of design talents in single digits, and these people become promoters of social changes, makers of intangible assets and creators of new values. They are committed to "wicked problems" and "painful crosses" in areas such as financial services, health care, social changes and so forth, looking forward to triggering the genetic mutations described in Darwin's theory of evolution in these areas. Their focus has gone beyond the first and second sequence of design (language and logo design, tangible object design) and entered the third and fourth sequence of design (system design, integrated innovation design) (Buchanan, 2001).

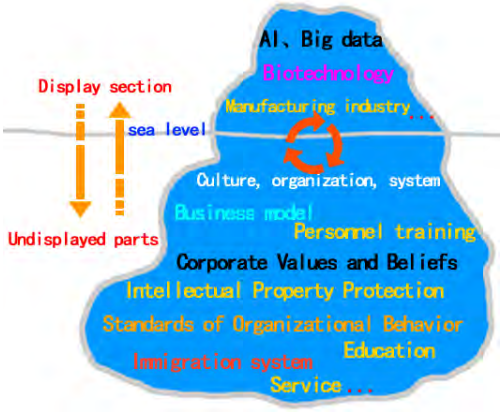
Therefore, the fundamental extension in the connotation of current design has already taken place, leading to a broader study and more service objects. This change is transformative and completely breaks the shackles of traditional design cognition. The reform and evolution of design can be used as new products to promote the innovation and upgrading of economy, politics, and culture.

3 Three Dimensions of the Innovation Strategy in China

3.1 "Iceberg" model of the innovation strategy in China

Zhang et al. (2015) pointed out that the construction of an innovative country requires strengthening the "hard" fundamental support for innovation-driven development, making more efforts to tackling key technologies in major cutting-edge areas facing the needs of the state strategy, and integrating resources to build a number of infrastructures and platforms that support high-level innovation; at the same time, it is necessary to consolidate the "soft" foundation of innovation-driven development, improve the system of talent introduction and training, promote education reform, strengthen education in entrepreneurship and innovation, and reinforce the long-term mechanism of intellectual property protection. As a result, the innovation strategy in China is like a model of an iceberg (Figure 1), with both the visible "hard" foundation and the invisible "soft" one. These two parts constitute a whole. They mutually support and promote each other to achieve common development. Following are three points that we should notice.

1. The boundary in the iceberg model—sea level will change up and down as tides will rise and fall. Visible and invisible parts will change constantly, which is a dynamic interactive process. In addition, the iceberg model is in the ocean current, and elements in it flow up and down along ocean currents like nutrients in the ocean so that no elements in the model can be rigidly understood. For example, artificial intelligence also has invisible content like culture, organization, etc.; intellectual property protection also has the existence of manufacturing and other entities.
2. The "iceberg" model is just like the Actor-Network Theory in the sociology of science. Every actor in the network is equal, and every actor will be translated to push the expansion and change of its system forward. Therefore, we should treat every element of the iceberg model equally.
3. The misplacement of stakeholder communication will lead to the implicit fragmentation of these two parts, resulting in the absence of interactive development mechanisms and policies between them. China's innovation strategy requires efforts in both explicit and implicit parts by keeping balance in all respective fields to make common progress. The relationship between the two fields in the innovation strategy of China is consistent with the principle of human walking, and they must promote each other, develop in coordination with each other and walk solidly step by step.



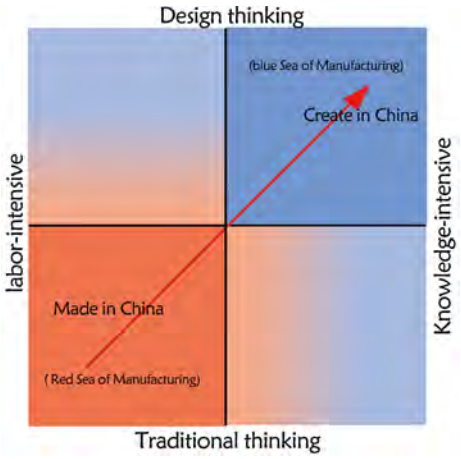


Figure 1. "Iceberg" Model of China's Innovation Strategic. Figure 2. Strategic-oriented Quadrant Map of Manufacturing Industry. Source: Drawn by the Author.

3.2 The "presence" and "absence" of the innovation strategy in China

Philosopher Heidegger pointed out: "the so-called presence is what appears or the meaning of something present; the so-called absence is what doesn't appear or the meaning of something absent. We cannot always stare at what is present at the moment, but go beyond it, beyond something absent and linkage of all sorts behind us, combining the presence and absence together as a whole" (Pöggeler, 1989). Following are two points concerning with it:

1. The first-order comprehension of "field theory" in the philosophical level—what appears is the real presence of the object (presence), and this object is a real object. Take the phenomenon of rain as an example. We can see the falling water, but the formation of rain and rain recycling don't appear (not present) when it rains, which is the simplest model in "field theory".
2. The second-order comprehension of "field theory"—what appears is not real, invisible but deductive, statistical or abstract (absence). For example, aging is getting worse and worse, and we can't really see it. However, we can count it out. Of course, how to solve this problem is even much more impossible to appear to us, and the solution is also intricate and has a huge system (not present). It is not only the absence of time but also the absence of the solution system.

Most of the problems facing China's innovation strategy are so complex that they need to be understood at the second-order level. For example, the "labor-intensive" domestic manufacturing is in urgent need of transforming and upgrading, resulting in the "qualitative" transformation from "made in China" to "creating in China" (Figure 2); Land desertification is increasingly aggravated; the contradiction of trade war needs resolving by "artistry"; the "dividend" of domestic labor force is declining year by year; the shortage of medical resources, the hardness and high expense of seeing a doctor still exist…These "sinister problems" cover many areas such as economics, medical treatment, education, health, diplomacy and so forth, so that solving these problems for our country and society requires the "Blue Sea" Strategy of Innovation China. Every solution to them is a complex and important part of China's innovation strategy.

If the challenges of China's innovation strategy are "the present absence" in the sense of philosophy, the solutions to them will be "the absent presence". These problems must be solved by cooperation in different fields, all-round innovation from different angles, research crossing different disciplines, as well as summarizing the experience of the past, comparing the past with the present and looking forward to the possibility of the future. Therefore, the solutions to the problems are the art of integrating the "horizontal" of the subject and the "vertical" of time. This innovation strategy requires domain cooperation and temporal "hetero

spatial" linkages that cannot be captured or actually presented by human eyes. It requires us to play wisdom and subjective initiative to practice, to sum up, to think, the process of which is exactly the evolution from "present absence" to "absent presence".

3.3 The diversified fields of the innovation strategy in China

From the perspective of the importance of the innovative object, the innovative strategy in China needs to be pluralistic. The development of aircraft carriers, the invention of JF-17 fighter air-crafts and the International Space Station are, of course, important support for the innovation strategy of China. However, the left-behind children, the improving efficiency of public services and other areas also play an important role in it because the innovation in these areas are closely related to the well-being of people's livelihood. The government work report at the 19th session of the national congress of the communist party in China pointed out: "Currently the main contradiction of society has been transformed from the contradiction between the increasing material and cultural needs of the people and the backward social productivity, into the one between growing needs of the people for a better life and unbalanced and inadequate development". Consequently, the improvement of people's livelihood and the increasing of all people and society's well-being also play an important part in the innovation strategy of China.

From the perspective of materialism, diversification is also very necessary. Highway, rail transit, aircraft armor and other material areas are indeed the urgent need of creating an innovative China. However, we should realize that in the 21st century, society is the one filled with information technology and "smoke-free" competition. Many innovative forms of output are no longer physical, but virtual, invisible and untouchable, such as digital community, money virtualization, virtual reality, changes in payment methods, etc.,These non-material perspectives of innovation also matter for the present innovation of China's construction.

4 The Coupling Logic between Design Reform and the Innovation Strategy in China

4.1 A sustainable ecosphere formed by design reform and China's innovation Strategy

The ecosystem is the unity of living beings and environments in certain space of nature, in which beings and environments interact and restrict each other and stay relatively in a stable dynamic equilibrium in a certain period of time (Liu, 2018). The innovation ecosystem is an ecological chain composed of each innovation subject, link and factor in a certain region, which is interrelated and dependent on each other. The combination of innovation ecological chains among different elements, domains or industries form a regional innovation ecosystem (Chen, 2017). The innovation strategy of China is also a big ecosystem, and design reform is an important element in it. Design reform helps push the strategy forward and in turn, the strategy also needs the reform. The relationship between them is similar to that of the ecosystem and its components (abiotic matter and energy, producers, consumers, and decomposers), the absence of any of the elements will undermines the stability and balance of the ecosystem itself.

On the other hand, The system of the innovation strategy in China contains a series of sub-systems, such as science and technology innovation, management innovation, culture innovation and so on, which need integrating into the entire system to maximize their energy. Design plays a key role in this large ecosystem of innovative strategy in China, the role of it has been shifted from solving simple problems to complex ones; from emphasizing a single principle of independent work to cross-functional teamwork. The design of new framework and content not only play a leading role in the innovation ecosystem, but also coordinate the natural and smooth meshing operation of each subsystem like the lubricant of gears and

build a platform on which scholars of respective disciplines and fields can exchange and absorb knowledge.

4.2 The consistency of philosophical "field" between design reform and China's innovation strategy

As mentioned above, new changes have taken place in design, defining a new research framework: from focusing on the "material attributes" of the product to the "behavior attributes"; from the aesthetic issues of product appearance to the behind, such as brand building, user's experience and service contact, even including social life and economic condition. Therefore, the focus of design reform has shifted from just "presence" to both "presence" and "absence". Its research object has been greatly expanded and extended. When it comes to the problems of "presence", the innovation strategy of China also needs to study the social background, technical means and the innovation basis of "absence". Their common "field" is overlapping and similar.

Moreover, the driving force of design reform has been shifted from "presence" to "absence" promoted by the innovation strategy in China. Before the main drivers of external innovation were new technologies, competitors' behavior and market research (presence), but now they prefer internal drivers such as unique insights, visions, the experience curve and empathy (absence). It is the motive to solve the problem of "presence" faced by the construction of external innovation in China that triggers the change to "absence" in the driving force of design innovation; it is also related to the fact that the traditional "field" force cannot solve the problem of "uncertain logic" and "alienation barrier" in the field of "absence" in the construction of innovation in China, triggering a fission reaction. Meanwhile, the design of the internal driving force of innovation and external force is not separated. The complex external changes and influences of the "presence" have been internalized into the creative power and design thinking of the "absence" and rooted in the "soil" of the unique culture of design-driven innovation, which was then used as the "catalyst" of the national innovation strategy.

4.3 The "co-creation" effect between the innovation strategy in China and design reform

From the macroscopic perspective, as one of the important strategic decisions in China, constructing an innovation-oriented country not only receives a great degree of support in policy but also receives a wide range of it. For example, *The Outline of the Thirteenth Five-Year Plan for Economic and Social Development for the People's Republic of China—the Chapter of the Implementation of National Innovation-Driven Development Strategy Program, Decision on the Implementation of Outline of Science and Technology Plan to Enhance the Capacity for Independent Innovation, Decision of the State Council of the Central Committee of the Communist Party of China on the Implementation of Outline of Science and Technology Program to Enhance the Capability for Independent Innovation and Report on Building an Innovative Country (2015—2016)*. From the microscopic perspective, the contents listed in table 2 focuses on some details and highlights of the implementation of the innovation-driven development strategy in China's outline. It can be seen that: (1) the diversification of the strategic layout determines that the policy needs to be designed from the view of multiple levels and angles, which is consistent with the new content of design reform. (2) the concrete measures of China's innovation strategy and the new framework of design reform have the common connotation in many fields, such as focusing on bottlenecks of modern agriculture, urbanization, environmental governance, healthy aged care and some other areas to formulate the scheme of systematic technical solution; shifting the focus from solving current problems to facing development in the future and so on.

On the other hand, the general program and policy established by the innovation strategy of China are also of leading help to the stakeholders of design reform, which is like navigation, enabling the brand car Rolls-Royce in design reform to drive in the direction it guides. At the same time, the detailed clauses in the general program also give a precise response to

design reform. Design reform, an invisible benefit, will "grow" more vigorously with the assistance of these policies. Therefore, the "co-creation" effect is the inevitable result of the innovation strategy of China and design reform.

Table 2 the Summary Contents of China's 13th Five-Year Plan Outline: Implementing Innovation-driven Development Strategy

Country	Plan	Time	Main Contents	Main Highlights
China	The Thirteenth Five-Year Plan	2015 — 2020	Strengthen the leading role of scientific and technological innovation: promote innovation breakthroughs in strategic frontier areas, optimize the innovative organization system and enhance the basic ability of innovation. Construct the institutional mechanism of stimulating innovation: deepen the reform of science and technology management system. Implement the strategy of giving priority to the development of talents: build a large-scale talent team, promote the optimal allocation of talents and create a good environment for the development of talents.	Accelerate the breakthrough of core technologies in the fields of the new generation of information communication, new energy, new material, aerospace, biomedicine and intelligent manufacturing and so on; focus on bottlenecks in modern agriculture, healthy old-age care and public services to formulate systematic technical solutions; accelerate the cultivation of new external economic advantages with the core of technology, standard, brand, quality and service.

Source: China's 13th Five-Year Plan Outline: Implementing Innovation-driven Development Strategy

5 Case Analysis: the Malan-Lake Desert Project

5.1 Situation of the Malan-Lake desert

The Malan-Lake Base (Figure 3), located in China's fourth largest desert, the Tengger Desert, is situated in the southwest of Alxa Left Banner in Inner Mongolia's Autonomous Region and the border of Gansu province. So far it has a total land area of 42,700 square kilometers and is continuously expanding. Besides, the area is suffering from water resource shortages, high degree of desertification and serious salinization of land, therefore, its ecology environment is extremely fragile.

Figure 3. The Location of the Malan-Lake Base. Source: Baidu Map. Figure 4. Vigorous Plants in the Malan-Lake Base. Source: Photographed by Bowen LI.

In April 2011, with a passion for public welfare, an entrepreneur in Hong Kong named YUAN Shuhua applied for and then founded Alashan Alliance Springfield Ecology Limited and promoted the Malan-Lake reforestation project. Six years have witnessed that 20 square kilometers of desert was almost all afforested (Figure 4) with a total 70% survival rate of plants. However, the Malan-Lake project being conducted for six years, has encountered

severe challenges during its development. For example, desert control is a cause with high investment, great difficulty, low efficiency and little return in the short term; the project did not raise any attention in society for lacking shared communication and social impact.

How to innovatively solve the problem of desert control with the power of design revolution has always attracted Professor XIN Xiangyang, School of Design, Jiangnan University. In 2017, Professor XIN has set up an interdisciplinary team composed of 12 people (team members come from design, biology, architecture and other research fields; the author is one of the team members), trying to explore the new path of desert control with design methods.

5.2 Design practice and desert control innovation

After hard work for more than three year, team members comprehensively analyzed the specific problems, opportunities, stakeholders and strategic positioning of the Malan-Lake Base, and then formed the initial scheme of the project.

5.2.1 The contents and objectives of design innovation

Controlling a wider area of desert is only one purpose of preventing desertification. Another important appeal is to attract more people to participate in it, fundamentally change their understanding of desert control and finally alter their cognition, behavior and even lifestyle. Therefore, the ultimate aim of the project lies in constructing an open and multi-functional community. Many potential investors involving the local farmers, herdsmen and people with the same values can be drawn by this community to achieve sustainable development of desert control and to inspire stakeholders to rethink the relationship between human and nature (Figure 5). Consequently, the design content of the project is no longer limited to the attributes of object but also highly related to the elements of "non-material logic", such as information, economic benefits, culture and so on which all require considering.

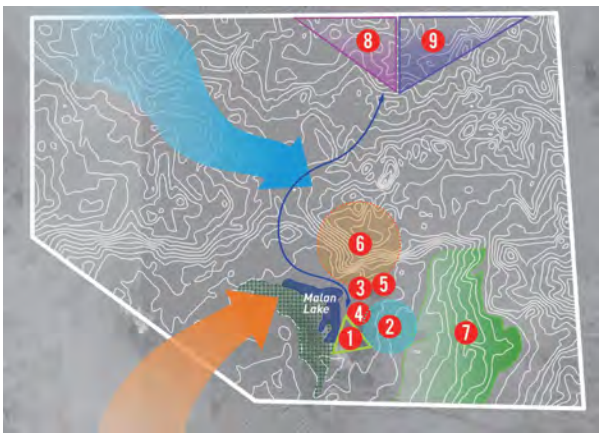


Figure 5. Relationship Map of Stakeholders in the Multi-functional Community. Figure 6. Design Scheme of the Multi-functional Community. Source: Publicity Manual of the Malan-Lake Project.

5.2.2 The presentation of design scheme

The overall planning of multi-functional community in the scheme includes nine themes (Figure 6) which include (1) Main Building; (2) Co-construction; (3) Desert Kitchen; (4) Bonfire Party; (5) Star-watching Platform; (6) Recreational Area; (7) Planting Experience Area; (8) Orienteering; (9) Desert Safaris. Among them, Main Building should include guest rooms, restaurants, conference centers, exhibitions and other functions; Supporting Building mainly includes staff dormitories, power supply, warehouses and other logistics rooms; Infrastructure should include swimming pools, parking lots and other functions. Co-construction mainly refers to the exhibition of conceptual models by designers through

competitions, during which the investors choose the excellent scheme to construct the real building, and the follow-up income of it belongs to the investor. It should be noted that the area of these buildings and the selected materials will be audited by the organizer. Desert kitchen is a kind of desert experience project based on catering, emphasizing nature and characteristics. Visitors can not only enjoy the unique Mongolian cuisine, but also personally participate in the food production to learn it. Recreational Area mainly includes beach volleyball, beach sunbathing and other projects. In addition, other thematic entertainment concepts created by multi-functional communities can all make tourists fully experience desert culture with unique regional characteristics.

Figure 7. Conceptual Scheme of Main Building in the Multi-functional Community. Source: Drawn by Bowen LI.

5.2.3 The desert changes driven by design

According to the conceptual planning scheme provided by the design team, the Malan-Lake community has established the brand of desert agricultural products called "Cao Muyuan" and planted a large number of medicinal materials and fruit trees such as sandy plants, cistanche deserticola Ma, cynomorium songaricum, lycium barbarum in the "Planting Experience Area". The community takes advantage of the rich natural resources such as solar energy in desert areas to vigorously develop new photovoltaic energy. "Co-construction" project, the "Main Building" (Figure 7) and "Star-watching Platform" make the most use of "photovoltaic" energy to promote the tourism, providing more jobs and choices. The unique natural scenery of mystery and exploration provided by desert tourism such as "Orienteering" and "Desert Safaris" cannot be replaced. Therefore, the desert tourism project is gradually attracting more and more adventurous tourists. From July 4 to 7, 2019, XXY Innovation, Alashan Alliance Springfield Ecology Limited and Guanghua Design and Development Foundation jointly launched the 2019 Malan-Lake Desert Volleyball Competition and Workshop for Sustainable Desert Development. These innovative designs enable stakeholders in desert control to form cooperative symbiotic relationships and gradually achieve the planning objectives of integrated the desert tourism communities.

5.3 Enlightenment:

In this case, the design discipline intervened in the innovation of desert cause and considered this social problem—desert control from a unique perspective. Design discipline breaks through the original boundary and creatively integrates diet, entertainment, adventure and other contents into desert control, which provides some new ideas of it. Undoubtedly, the design revolution here is an important content and driving force of China's innovation strategy.

6 Conclusion

The new mission of design has become the important measure to solve the "wicked problem" in the process of social development and to promote the national cultural soft power; it has also become an important way to promote the innovation of products and services, to meet diversified consumption needs and to improve the quality of life (Xin, 2016). The reformed "new design" has not only become a football player of "heavy gunner" to solve the "road rover" and "difficult bone" encountered during the implementation of the strategy, but also play the role of "professional broker". In addition, the innovation strategy of China also provides a rich "culture medium" for design reform and provides the correct direction to develop, just like the "watchtower". This mutual promotion and common development of the benign coupling relationship help design reform and the innovation strategy of China all make great achievements.

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Design Capability Building in City Government

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Government Innovation Labs are characterized by a direct connection with the public sector and created to tackle complex challenges that more traditional governmental structures seek to resolve. They are often working on a project basis with internal staff members to design innovative governmental services and policies, but they are also on a longer-term mission of changing the way governments operate. This longer term mission is what this study is interested in. Design capability building, in particular, is the focus of this paper. The way design capability building is approached in government context has been critiqued to be too focused on design methods and tools taught through workshops or short classes. The understanding of how we might increase design capability building in government context is limited. This calls into question how Government Innovation Labs may continue to increase design capability in city government. This paper aims at (1) highlighting the multiple meanings of design capability building on the basis of an existing theoretical model proposed by Lisa Malmberg which combines three modes of interpretation of design capability building: awareness of design, design resources and enabling organisational structures for design practice: (2) contributing to the service design literature with two state of the art case studies – *Civic Service Design Studio* in New York City and *Innovationshuset* in Copenhagen – which exemplify how all three modes of interpreting design capability building play out in practice; (3) reflecting on the role of Government Innovation Labs in building design capability.

Keywords: Design capability building, enabling organisational structures, service design, government

1. Introduction

Public problems are increasingly ill-defined or wicked (Rittel and Webber, 1973) or even super wicked (Banerjee, 2014) meaning unclear, complex and interdependent, with unpredictable dynamics and changing at a fast pace over time. Attempts at problem solving change the problem itself (Martin, 2009). This is the case of typical challenges public administrations are facing now – such as urban sustainability – and they can no longer be addressed with a traditional practice of problem solving.

At the same time collaborative design practices, such as service design (Blomkvist, Holmlid, & Segelstrom, 2010; Meroni & Sangiorgi, 2011) or co-design (Blomkamp, 2018), are increasingly seen as a potential response for addressing ill-defined public issues (Rittle, 1972; Cross, 2004; Design Commission, 2014; Manzini, 2015; Thorpe, Prendiville, & Oliver, 2016; Bason, 2017).

In this context, governments in various parts of the world have started to internally hire designers that are experts in collaborative practices – such as service designers (Blomkvist, Holmlid, & Segelstrom, 2010; Meroni & Sangiorgi, 2011) – rather than using external design consultants. To name just a few: *Laboratorio de Gobierno* in Chile, *Laboratorio para la Ciudad* in Mexico, *Alberta CoLab* in Canada. These units are commonly referred to as Government Innovation Labs, a "specific type of Public Innovation Place characterized by a direct connection with the public sector and created to tackle complex challenges that more traditional governmental structures seek to resolve" (Selloni, et.al, 2013). They are often working on a project basis with internal staff members – policy makers, public managers, public servants – to design innovative governmental services and policies, but are also on a longer-term mission of changing the way governments operate (ibid).

This paper is focusing on the "longer-term mission" of Government Innovation Labs, in particular, on the activity of *design capability building*. Some authors in the design literature noticed that there is a lack of consistency in the use of this concept (Mortati, et.al, 2014; Malmberg, 2017) and pointed that *design capability building* is often approached and limited to workshops/classes that are supposed to upskill government staff at design methods and tools (Malmberg, 2017; Blomkamp, 2018; Mortati, et.al, 2018).

This paper builds on a theoretical model proposed by Malmberg (2017). While Lima and Sangiorgi (2018) addressed a gap identified at the core of this model by adopting a knowledge transfer view on design capability – expanding the understanding of the factors that might affect the transmission of design knowledge in organization –, this paper uses the model of Malmberg as lens on two cases of Government Innovation Labs in order to characterise how design capability is defined and approached as well as to reveal how organisational conditions are developed to increase design capability in city government.

The first section of this paper presents the main theoretical framework of this study; three aspects that characterises the concept of *building design capability* as it is debated in the design and management literature. The second section uses the theoretical framework of Malmberg (2017) as a lens to look at two cases of Government Innovation Labs – *Civic Service Design Studio* and *Innovationshuset* – that are positioned within government and operating on a city government level. The last section highlights strategies to build design capability beyond workshops, methods and tools and includes opportunities and questions moving forward.

2. Theoretical framework: design capability building

The *design capability* term has been extensively used, but not always in a consistent way. It is often confused with other terms such as *capabilities, capacity, design competence* or *skill* (Acklin, 2013). This lack of a clear and agreed upon definition was pointed out by Mortati, Villari and Maffei (2014) and recently investigated by Malmberg (2017) through a systematic review of the design and design management literature. Her literature review showed that "the term *design capability* is the most commonly used in relation to an organization's use or the development of use of design." She further clarifies that "design capability is used both in relation to the qualitative and quantitative aspects related to an organization's acceptance, understanding, and use of design". Shortly put, design capability is about "an organization's ability to utilize design" (Malmberg, 2017, p.50). Design in her work is understood as "an approach to development that brings with it methods and tools that ensure a user-centered and open mindset and attitude".

Even more interestingly, Malmberg (2017) identified three overlapping patterns or aspects that characterise how design capability is used in literary discourses. These three aspects constitute what Malmberg titles “a tentative model of design capability derived from the use of the concept in the literature” – also, the theoretical model originally incorporates (fundamental) dimensions of transformative and organisational learning, however, for the sake of length and focus, this paper uses only the three dimensions described in figure 1.

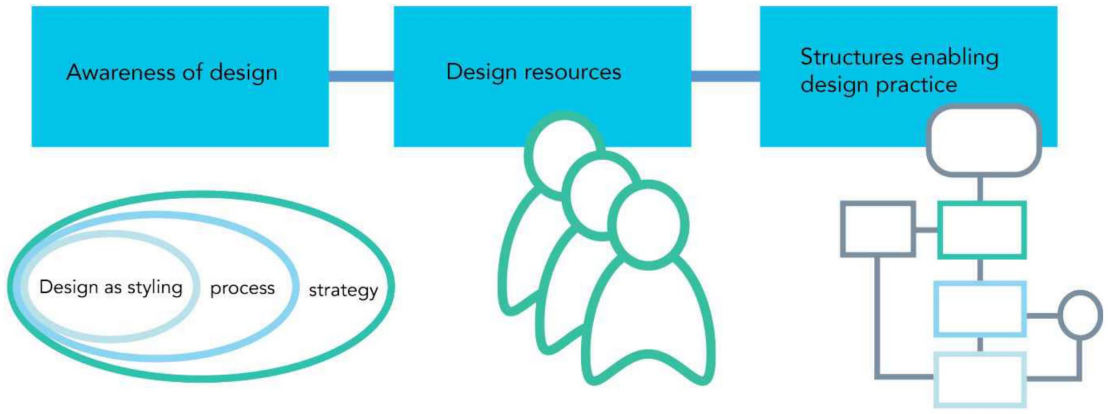

Figure 1. A tentative model of design capability. Source: Malmberg, 2017

2.1 Design capability as awareness of design

The first aspect Malmberg (2017) found is design capability as *awareness of design,* which is about developing the perception and understanding of design’s contribution by an organization. All sorts of communication artifacts and other means are used to increase the knowledge an organisation has about design. This aspect is often discussed through ladders of maturity, for example the *Design staircase* which shows design being either perceived at a low level, *styling*, at the middle level, *process,* and at the highest level, *strategy* (Ramlau, et. al, 2004). Awareness of design can also be understood the other way around, not necessarily the organisation being aware of design, but also expert designers recognizing existing design traditions in the organization as Junginger (2014) calls *organizational design legacies*. In her view, design is already embedded into organisations as “every organization develops and establishes certain kinds of design practices, design concepts and design approaches over time. This means that at best, we can introduce new design practices and different ways to think of design into organizations.” This aspect of awareness of design shows that the idea that a designer or an organisation may have about design plays a determinant role in building design capability.

2.2 Design capability as design resources

The second aspect is design capability as *design resources* which is “in relation to the design competency, skills, or activities brought by trained designers or the use of a design methodology” (Malmberg, 2017, p. 51). Design resources can be developed through the employment of expert designers – everybody can turn a situation into a preferred one but some people become experts at it after long years of design education and training (Manzini, 2017) – or through training of staff in design thinking methods and tools. Setting up new facilities can also be considered design resources. According to this logic, having access to

design resources means having access to a number of people with design competences (Malmberg, 2017, p.51). Therefore, if one embraces this understanding of the notion of design capability then one may think that the more people with design competences there are in an organisation, the more this organisation increases its design capability. This logic explains why numerous expert designers offer training workshops or programs in design thinking or service design methods to design-novice organizations.

2.3 Design capability as structures enabling design practice

The third aspect that Malmberg (2017) identified in the literature is design capability as *structures enabling design practice* or also labelled *enabling organisational structures*. This aspect emphasises an organization's ability to make use of a design practice or design resources (Malmberg, 2017, p.55). *Enabling organisational structures* is an aspect of design capability that can be seen at the intersection of design and management, as it is more about supporting and managing design resources in a way that makes them easily exploitable. Indeed, organisational structures – labour division and coordinating mechanisms – can be designed and affect an organisation functions, meaning "how materials, authority, information, and decision processes flow through it" (Mintzberg, 1979, p.65). Malmberg (2017) reports several authors who refer to this aspect as design mana*gement capabilities* (Cantamessa, 1999; Acklin, 2013; Mortati et al, 2014). In short, understanding design capability building with this logic comes down to the question of how best to adapt/design structures of an organisation to facilitate the use of the particular design resources that are present in the organisation.

Table 1 summarises the three aspects presented above.

Table 1 Tentative model of design capability building. Source: Malmberg, 2017

(1) Awareness of design	(2) Design resources	(3) Structures enabling design practice
Individual level		*Organisation level*
Developing the perception and understanding of design's contribution by an organisation from design as styling to design as process then strategy. Expert designers recognizing existing design traditions in the organisation.	The more people with design competences the more the organisation increases it design capability. Ex: Employment of expert designers, training of staff in design thinking methods and tools or event, creative facilities.	Organisation's ability to make use of a design practice or design resources. How best to adapt the structures of an organisation to facilitate the use of design resources? At the intersection of design and management.

2.4 Relations between the three aspects

What the work of Malmberg informs us about, more than unpacking the *design capability* term and demonstrating the existence of multiple interpretations, is the complementary and interrelated nature of the three aspects that characterise design capability building. Malmberg (2017) states, based on the work of Beltagui et al. (2011), Body (2008) and Mutanen (2008):

> *"The argument that some of the abilities put forward as design specific are in fact already present but not articulated in organizations suggests that design capability is not only a matter of holding specific skills and competence or executing certain activities. Design capability must also entail an understanding of what value these skills could potentially contribute and the ability to enable the exploitation of the skills to create that value and ensure the effective use of design."*

In other words, there must be a certain level of *awareness of design* for an organisation to have an interest in developing the corresponding *design resources*, however, the organisation will not be able to tap into these resources if there are no efforts in creating corresponding organisational structures; ones that enable the use of these particular kind of design resources. We can also reflect on the reverse effect, there might not be efforts dedicated to that aspect because of a lack of *awareness of design* or *design resources* in the organisation. This interdependence shows that an organisation will not increase its design capability by solely focusing on its *awareness of design* or the development of *design resources*. The organisation must also make sure to develop the "right" structures that can enable the use of the design resources in place. (Malmberg, 2017, p.65). "The ability of an organization to utilize design in its development work (i.e. its design capability) is dependent on both its awareness of design and the structures that enable design, and its resources." (ibid).

2.5 Knowledge gap

What Malmberg eventually points out through her PhD thesis is the lack of emphasis on the development of enabling organisational structures for collaborative design practices, in public sector particularly. Indeed, public sector organisations are known to be highly bureaucratic in a way that prevents any kind of innovative practice to be brought in. Vibeke Carstensen and Bason (2012) talked about an "anti-innovation DNA" referring to hierarchy, bureaucracy, organisation silos, vertical and horizontal sectorisation and traditional roles; they asked whether collaborative policy innovation labs could help and examined one case – Mindlab, Danish government innovation lab. They emphasised as well the role of organisation structures:

> *"They (participating Ministries) are in very different stages of innovation maturity, and their use of project models and organisation structure has a great impact on the cross governmental unit's ability to carry out its work. The MindLab experience is that all participating ministries need to have a well defined and functioning project model, and that it is helpful if they have the same degree or maturity in engaging in creative thinking."*

Mindlab was a pioneer lab, operating on a federal level since 2002. How have other and newer labs, in local government level, addressed these challenges? In this paper the author uses the "tentative model of design capability building" of Malmberg (2017) to look at two cases of Government Innovation Labs working at the forefront of their field in Copenhagen Municipality and New York City government.

Before the analysis, the following section presents additional contributions found in the design literature that connect with the studies of Malmberg, Vibeke Carstensen and Bason.

2.6 Additional contributions from the literature

Other key authors in the design literature recently drew similar conclusions and point out the need to increase design capability in government or public policy context beyond the teaching of methods and tools.

Blomkamp (2018, p.10) clarified the definition of co-design for public policy and emphasized that "embedding design into government is not just about upskilling policy workers on designerly methods, but also about bringing other disciplinary knowledge into the design process and will likely require cultural and structural change to enable different approaches to be applied."

Likewise, Mortati, Christiansen and Maffei (2018) warns that "the frequent underestimation of what it takes to enable a useful uptake of innovation approaches and methods – including design – is concerning". As a reason, the authors introduced the term *design craft in government* in the service design community and called for *more craft than method.* In their words, *method* refers to "the technical ability to learn, take up and apply design as a new kind of approach and process in public development practice". Invoking design as a "craft" in governmental context is in their view a way to push design closer to tackle "the core of government operations." To do so, they suggest a simplified but clear way to categorise design-led innovation in government into the following dimensions:

> *Principles: For a new method to be strategically applied and sustained over time as a new way of working (going beyond single projects or pilots), there has to be continuous focus on how design changes the culture of the organisation. This includes learning and rehearsing what kinds of mindsets and habits follow from doing design-led work in government and allowing for public officials to explore the meaning and value of design.*
>
> *Conditions: Any successful application of design in government is dependent on the ability to create the appropriate conditions and enabling environment to strategically support the process. Consequently, there is a need to have a systematic focus on how to lead, organise for, manage, support, incentivise and sustain design-led innovation in public organisations.*
>
> *Functions: To make the most of design, there is a need to systematically explore how to embed design approaches in core government operations, structures and roles - for example in public policy, procurement, HR, or regulation practice (going beyond setting up dedicated design labs and teams).*

Although this categorisation offers a simplification of reality, one can already perceive the complex entanglement between all the components of an organisation, in particular cultures and organisational structures. Striving to change a culture in an organisation also means to put efforts into changing the organisational structures that allow for this culture to be expressed.

As the literature presented suggests, organisational structures are an important factor that needs to be tweaked and systematically assessed for a new design practice to be exploited. Recent cases are needed to understand how that could be done in practice.

3. The cases

This section looks into two cases of Government Innovation Labs through the lens of the tentative theoretical model “Design Capability Building” by Malmberg (2017) – presented in section 2. The analysis is conducted in two iterations and reveals two layers of actions; one ‘visible’ which confirms what the literature is pointing at and one ‘invisible’ which reveals hidden and inspiring strategies beyond workshop methods and tools for building design capability in a local government.

3.1 Introduction to the cases

Civic Service Design Studio and *Innovationshuset* are two Government Innovation Labs. They were selected for this study because they are state of the art cases and although the teams are operating in very different political, social, economic and cultural contexts – one is in New York City, the other in the capital of Denmark, Copenhagen – they were judged comparable because both are operating within municipal government level, using service design and co-design processes to rethink public services for the benefit of citizens and have design capability building as one of their main missions. The table below presents further characteristics based on the *Gov Innovation Lab Constellation* (Selloni, et.al, 2013) as well as other characteristics relevant for this study.

Table 2 General characteristics of Government Innovation Labs studied

Name	Civic Service Design Studio	Innovationshuset (Innovation House)
Created in	2017	2015 (closed January 2019)
Municipality	New York City government, USA (325 000+ employees for 8 600 000+ citizens)	Copenhagen Municipality, Denmark (40 000+ employees for 600 000+ citizens)
Positioned in / Owned by	Mayor’s Office for Economic Opportunity	Administration of Economy (2015-2017) Administration of Culture (2018)
Located in (figure 2)	Office of Mayor’s Office for Economic Opportunity	In its own building in Copenhagen, Meatpacking District
Role of government	Government as owner	Government as owner, funder and client
Activities	Research Communication Networking Capacity Building Design Piloting Advisory	Research Communication Networking Capacity Building Design Piloting
Status	Internal partner	In-house consultancy
Number of people in the team	14 (including 4 full time) in April 2019	30+ (including 5 full time) in February 2018
Major in function	Bill De Blasio (Democratic)	Frank Jensen (Social Democrats)

Figure 2 (Left) Building in which Civic Service Design Studio is located – 18th floor, February 2019 (Right) Innovationshuset facility, March 2018

3.2 Data collection method

In order to look at *Innovationshuset* and *Civic Service Design Studio* through the theoretical framework "Design capability building" presented in section 2, the researcher (author of this paper) followed activities of *Innovationshuset* Copenhagen from January 2018 until it closed down in December 2018, then followed activities of *Civic Service Design Studio* in New York City between February and June 2019. During these time periods the researcher used a mixed-methods research, a combination of several qualitative methods – participant and non-participant observation as well as contextual interview methods often supported by visual tools for conversation and the theoretical model presented section 2 – since the investigation was more about the *how* and the *why* than about the *how much* or *when* or *where* (Kara, 2015), in other words the investigation covered qualitative rather than quantitative aspects. Audio and video recordings, photographs, field notes, project reports, drawings as well as artifacts produced by the labs were collected thanks to eight key persons/informants in Case A and thanks to five key persons/informants in Case B. All the informants were people with a design education background working respectively in *Innovationshuset* and *Civic Service Design Studio* except one who worked in NYC Government as Senior advisor. The researcher also reviewed relevant material available online concerning *Innovationshuset* and *Civic Service Design Studio* – websites and social media profiles.

3.3 Visible layer

The analysis of the data collected was done in several iterations. The first iteration of the analysis focused on: how is design capability building defined by practitioners? What is it characterized by? The goal was to understand which aspects of design capability building practitioners referred to most. Increasing awareness of design or developing design resources or the development of enabling organisational structures?

3.3.1 Innovation and master class

At *Innovationshuset*, *innovation* was the key word. The lab was an *innovation house*, that helped with *competence development in innovation* which corresponded in practice to a master class (figure 3). Twice a year *Innovationshuset* taught a course in four modules, with two full-day classes in each module, over a period of six months. Employees – low management level – from the Public Administrations of Copenhagen Municipality applied for participation within their local administration. The participants were trained in four core elements of what *Innovationshuset* defined an innovation process: (1) the design process and tools, (2) design thinking, (3) co-creation and partnership development, and (4) return on investment. Each participant was required to bring their own project to use during the course.

In addition to this master class, every administration had several employees – project managers – who took the role of what was called *innovation partners*. He or she worked twice a week in *Innovationshuset* for an average period of six months. As the co-chief of innovation explained, the goal was for the employees “to gain design competences and innovation skills to take back home” meaning to bring back into their administration.

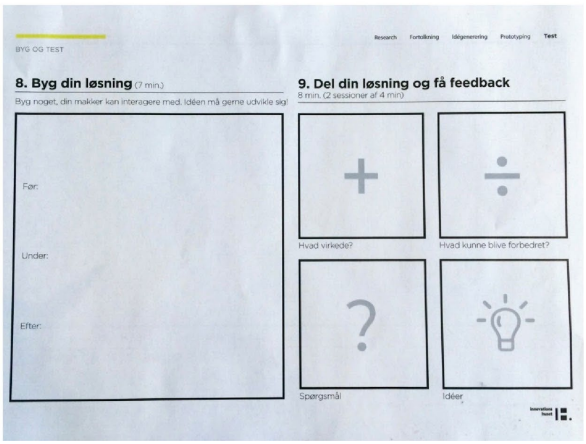

Figure 3. (Top) First day of Master class at Innovationshuset, 30th of January 2018 (Down left) Design thinking introduction in 1h (Down right) Design thinking introduction template page 8, 30th of January 2018

3.3.2 Design capacity, tools and tactics

At *Civic Service Design Studio design capacity* is the key word. In one of the interviews conducted, the researcher asked “what do you mean by building design capacity?” to the two design leads of *Civic Service Design Studio*. The first and most important elements to their eyes were:

- *Building capacity is giving people an understanding of the design process, why do designers do what we do when we do it.*
- *Teaching people methods and hard design skills such as making visual things, deconstructing data, talking to people, start small-get feedback-iterate-scale gradually, prototype, testing ideas before piloting.*
- *Demystifying design and building confidence in government employees to do/try parts of a design process in their day to day work.*
- *Giving people the frameworks and legitimacy to do what they are already doing.*
- *Supporting or building a community of practice for existing designers.*

In practice, that corresponded to the visible offer communicated on their website and to government staff:

- *Office Hours:* the team dedicates 4 slots of 1h meeting per week to offer guidance and support to any government staff of NYC government (or externals). According to a synthesis document produced by the design leads, after hearing attendee’s needs, the Studio member would generally provide support with (a) greater clarity, depth and nuance to the Tools + Tactics guide, (b) tactical project-based advises, (c) translating design methods and knowledge.

- *Tools + Tactics (figure 4)*: Tailored design methods and tools for the public sector context, available as open source on the website of *Civic Service Design Studio*, in a binder and in a small field guide as shown on figure 7. Tools + Tactics are categorised in the following way: (1) Set the Stage, (2) Talk with People, (3) Connect the Dots, (4) Try things out, (5) Focus on Impact, (6) Get more help (NYC Opportunity, 2019).

- Tools + Tactics in Action: Workshops providing facilitated training on service design. This type of support was requested in the Office Hours. The Studio also hosts bi-monthly *Civic Design Forums* in partnership with the Department of Information Technology and Telecommunications (DoITT) Gov Lab + Studio to share best practices and run product and service design workshops. (NYC Opportunity, 2019)

Figure 4. Tools + Tactics and supplies provided by Civic Service Design Studio to NYC government staff. Source: NYC Opportunity

3.3.3 Complying surface

Bridging the understandings of practitioners from *Innovationshuset* and *Civic Service Design Studio* with the "Tentative model of Design capability Building" presented in table 1, it appears clearly that the ways in which the activity of *building design capability* is defined and approached correspond to the first two aspects of the model: *awareness of design* and *design resources*. Even if the vocabulary used is different, in both cases the attention is put on the individuals – the people who are working in the government – to grow their perception and understanding of design as well as their competences and skills in using service design methods and tools.

These first findings complies with what Malmberg (2017), Blomkamp (2018) and (Mortati, et. al, 2018) were pointing at: the issue that building design capability in government context is too often approached and limited to the activity of upskilling government staff. However, further exploration of the cases has shown otherwise.

3.4 Invisible layer

The second iteration of the analysis consisted in looking deeper into what the practitioners were doing and saying while having in mind all three aspects of design capability building as defined in table 1. In particular, the researcher sought for elements that would correspond to the aspect of *enabling organisational structures* which were missing in the first analysis.

Several elements were found and indicated that both labs were concerned with organisational structures and core government processes and had strategies for it although there were indirect and not advertised.

3.4.1 Mapping organisation structures

Copenhagen municipality is complex. As the co-chief of innovation of *Innovationshuset* said: “So many different strategies, very big municipality, then very different departments, very different arenas whether you’re working with youth, schools, whether you’re working with elder care, it feels like not the same organisation.” Therefore, to cope with this complexity, *Innovationshuset*’s team used organisation charts as compass and navigation maps for facilitating their work with the administrations. The organisation charts of the seven administrations were graphically designed, printed on large posters and put on the walls in the meeting/team rooms as shown on figure 5. The posters were annotated and helpful as one junior service designer said: “It’s nice to see which people you need to get in touch with when you are in different projects.”

Figure 5 (Left) Organisation chart posters of Copenhagen Municipality (Right) Junior service designer pointing at a key layer for collaboration across administrations (right), 27th of March 2018

3.4.2 Having internal allies

Innovationshuset was considered as an ‘internal consultancy’, but was physically and strategically speaking positioned outside of all the administrations (figure 6). As a consequence the team was lacking internal knowledge and influence. That is why they used the role of *Innovation partners* as a strategy. As the co-chief of innovation said, having *innovation partners* was like “trying to hack their business as usual from within.” She further explained the reason for having administration employees in *Innovationshuset*: “If you want to be closed to all (departments), you need to have some insiders because you can’t be aware of all the strategies and the cultural differences and making all the connexions yourself. But that’s also because we were a consultancy.”

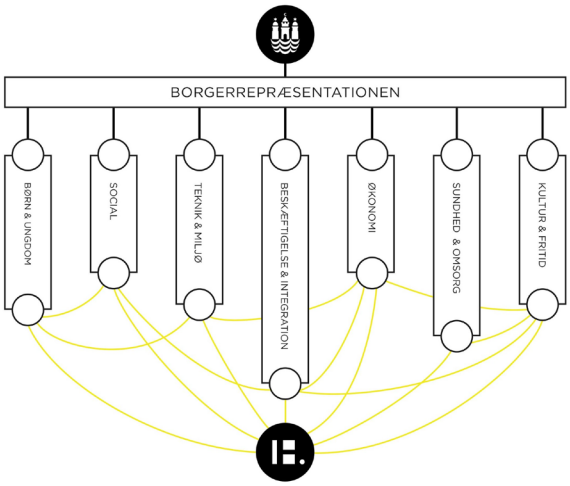

Figure 6 Diagram showing Innovationshuset's position (the black circle in the bottom) in relation to the administrations of Copenhagen Municipality. Source: Innovationshuset, January 2018

Similarly, *Civic Service Design Studio* mentioned the key role of a person that they call a *friendly bureaucracy hacker*, a term borrowed from people working in the City of Austin, which means someone in the government who is "good at navigating bureaucracy, advocating for the Studio to executive leaders and facilitating opportunities to happen". The person in question was leading a division which meant that he was positioned in a way that enabled him to interact with all the decision makers and to build relationships with leadership of all the divisions. He explained during an interview:

> "They (*Civic Service Design Studio*) say that (I'm a bureaucracy hacker) I think because everytime they push for us to adopt a type of design tool or tactic, I then have to say, that sounds like a great goal for us to achieve, now let's talk about the three to height people that we need to engage or not engage, depending on our strategy, to try to do that and implement that. And who do I need to have offline conversations with to warm them up to the idea, who do I try to lead to the very end so they don't create hurdles for us to cross that really don't need to be."

3.4.3 Influencing core procurements

In NYC government, a "Request for Proposal" (RFP) is the process by which the City solicits procurements, in other words purchases goods and services. RFPs are the vehicle for City agencies to conduct service design projects, and are opportunities to turn organisation structures into enabling ones for a service design practice. *Civic Service Design Studio* is not entitled to directly modify RFPs, however the team works with the agencies that are to write RFPs for service design scopes, and encourages agencies to write these collaboratively with relevant stakeholders.

4. Questions, opportunities and further research

The study of the two Government Innovation Labs cases, *Innovationshuset* in Copenhagen municipality and *Civic Service Design Studio* in New York City government, indicates that design capability building does happen beyond the teaching of design methods and tools to employees. However, this work is at first glance not so visible nor explicit. Indeed, Government Innovation Labs know the importance of adapting organisational structures to

more enabling ones, but they are not necessarily expected or entitled to modify them directly. That is why the labs find alternative ways to navigate in it, through mapping, they find internal allies and influence or advise the ones that are entitled to modify organisational structures.

Labs seem to be 'joggling' with their ambitions and what the organisation they are in can accept or tolerate. The risk of letting the work of a Government Innovation Lab appear as 'just' teaching new design methods and tools is that the Labs can be judged inefficient and get discarded by those in power who did not realise or knew about the actual breadth of the work required to generate impact.

Should the work of modifying organisational structures be more clearly visible and explicit up front to the organisation? A government could see it as a resource if it was explicitly stated and if the role of Government Innovation Labs was somehow codified and introduced in the organization as a normal practice. Another question is if it is Government Innovation Labs's role only? Or is it lying in the collaboration and joined efforts of executive leaders with Government Innovation Labs? As seen in this study, executive leaders can have a key position within the government to influence or even change organisational structures into ones that would be more enabling for collaborative design practices, but do they know how these new structures should be like?

In NYC government, the researcher recorded an *Office Hours* meeting (described section 4.3.2) which explicitly addressed organisational structures and leadership visioning. The participant of the meeting was a leader in one of the divisions of the Health agency and asked for feedback on a discussion guide and strategic plan. The leader wanted to interview her team about: "how might we use this strategic plan to design an optimal organisational structure for the division?" The topic of organisational structures was according to the leader "not unspoken, but spoken regularly" and recognised as a barrier. The leader explained what the team had reported: "we know how to do our work, but we need the structures that support it." The main issues the leader expressed about addressing this question were:

- *we want to get to more detailed into what organisational structures mean*
- *people have different point of view, how to deal with that?*
- *we have done interviews but we need the discussion to be more actionable*

This evidence indicates that leaders may not know what an enabling organisational structure is for a collaborative practice and lack the ability to facilitate a productive dialog with their colleagues and employees about this topic. Government Innovation Labs are instead limited by their status of new-in consultant or partner when it comes to modifying core government processes, however they have the ability to facilitate collaborative discussion that can lead to action as well as the ability to nurture the generation of alternative visions to inspire leadership and management.

Malmberg (2017) had advised practitioners *(1) the active involvement of actors with mandate to transform structures in the organization (2) time to develop design resources and enabling structures.* An addition to that could be: participatory interventions supporting these actors in defining collectively what enabling structures may be. Further research will explore these modes of intervention and take inspiration from the term 'enabling bureaucracy', suggested a long ago by Adler and Borys (1996) which may reconcile bureaucracy with design.

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Design for a Circular Economy: A Paradigm shift

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We are in a paradigm shift. A move from a linear destructive model to a circular and restorative model. This requires radical change in terms of business models, modes of operations and the design methods, tools and techniques used to design with intention. A new methodological framework is proposed and explored that crosses leading behavioural change research with emerging design through action research. It was found that the methodological framework is able to change norms, raise salience and so prime participants for ideation in a circular economy and that while this research is in early days it shows promise as a way to accelerate innovative concepts that can radically change an eco-system for a circular economy.

Keywords: Methodological Framework, Circular Economy, Emerging Design, Change

1 Introduction

We are in a paradigm shift, in the sense of Kuhn (Shapere, 1964) a move beyond, business as usual and linear economies to a circular economy (Stahel and Reday 1981) whereby business models and modes of operation require radical change and designers are progressively drawn into more fundamental phases of product (and system) evolution (Hall, 2011) with greater transdisciplinary collaborations (Stock & Burton 2011) to design for change (Banjeree 2008) with intension and for sustainability (Stegall, 2006) Design requires new methods, tools and techniques (Gardien, Djajadiningrat, Hummels, & Brombacher 2014).

Societal and environmental changes have urged governments to act immediately, to accelerate programs and business using radical changes to address the well-being of people and their environments overall (Paris Agreement cop21 2015, SDG 2016, G20 2018). Accompanied by exponential growth in technology processing power (Moore's Law), enabling distributed processing, has accelerated a paradigm shift through the 'experience economy', a linear business model with focus on the product and brand experience, and into the 'transformation economy' (Brand and Rocci 2011). In this new economy business behaviours and deliverables are valued for their holistic approach; beyond the design of the product or system and inclusive of social and environmental aspects; embedded in digital technologies. See Figure 1. (Gardien et al., 2014); (Bakker, Hollander, Van Hinte & Zijlstra 2014). "Our current consumption and production patterns are unsustainable" (Baldassarre, Calabretta, Bocken, & Jaskiewicz, 2017). There are significant benefits to moving to a circular economy as "regenerative loops aim to create, Innovation opportunity, Job creation, Economic competitiveness, Resource savings, Waste prevention"; and the principles of CE

aim to minimize a) inputs in terms of resources and energy and b) outputs as given as waste, emissions and energy loss. (Stahel and Reday 1981).

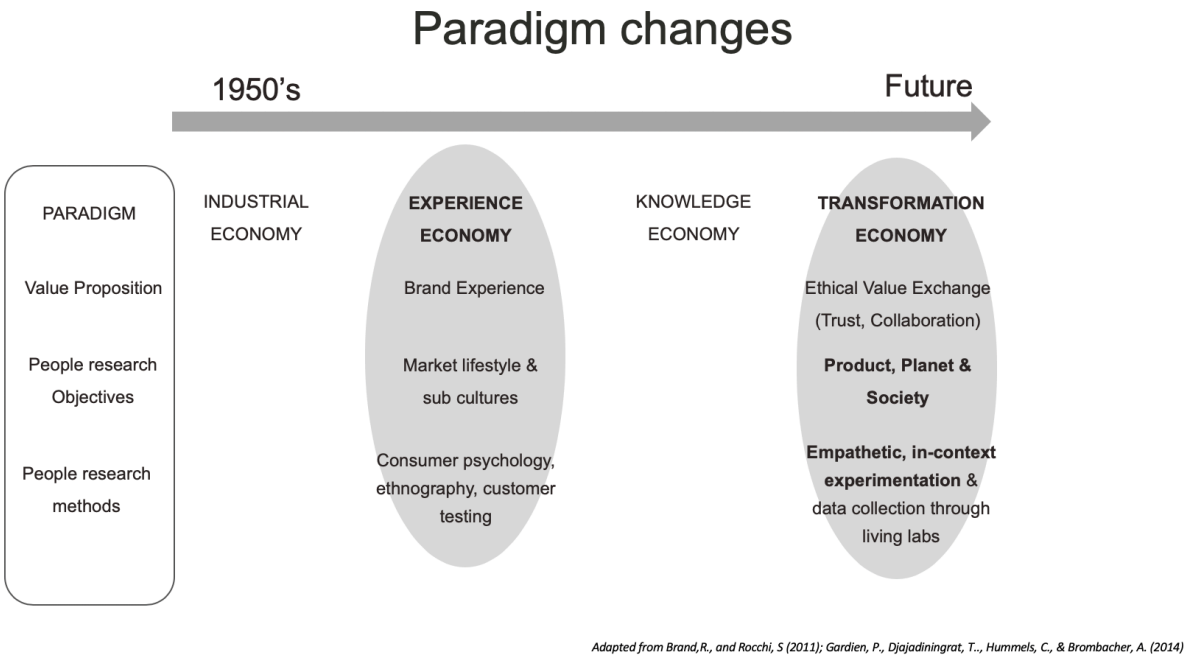

Figure 1: Paradigm Changes. Adapted from Brand,R., and Rocchi, S (2011); Gardien, P., Djajadiningrat, T.., Hummels, C., & Brombacher, A. (2014)

The European Union, (European Commission (EC) 2016) adopted the Circular Economy model " As part of its continuous effort to transform Europe's economy into a more sustainable one and to implement the ambitious Circular Economy Action Plan": this continues to evolve as measures for circular economy are added for implementation. The EC believes that change "must involve all sectors of the economy, including industry, transport, building and agriculture".

Yet only 9% of the planet is circular (PACE, 2019). The linear model continues to be the current norm and given the recent rise in levels of carbon dioxide outputs in 2018 accompanied by the geopolitical withdrawals and denials of climate change there has been a reversal in progress since the United Nations ratification in Paris (2015); (Nature 2018); (PACE 2019). "Next to the implementation of innovative technology, sustainable development based on innovative business models, better understanding of customer needs and behavioural change are crucial" (Baldassarre et al., 2017). This paradigm shift requires intentional design for sustainability that embodies the new purpose across the full eco-system (Stegall 2006). Intentional design is needed at the front end of the process to "inform and inspire open ended questions" (Sanders & Stappers, 2008); "design out" adverse consequences (Cross 1972): as only designing with intention can designers reach circular economy goals towards sustainability.

For these reasons this study explores through action research a new methodological framework (Seago 1994/5) with motive to explore, support and accelerate the design of novel business concepts for a circular economy using a systems and design thinking approach: in the sector of food and agriculture. Action research is used as it allows the researcher to explore the potential of the methodological framework in context and in this

way evaluate the concept outcomes in a real world environment. (Frayling (1993); Seago 1994/5))

2 Context

This action research is part of a larger study comprising of a series of six trials, that explore the use of a new methodological framework to create through transdisciplinary dialogues (Banerjee 2008), located at and beyond the leading edge of designing for sustainability (Stegall, 2006) that seek to propose new opportunities that can evolve technologies, markets, user expectations and behaviours (Hall 2011) for a circular economy. This work explores the scenario of the food system, as it is one of the largest contributors to climate change and requires radical transformation (Willet et al., 2019). This work develops use of theory and builds on author learning from previous action research in food and agriculture with intention to innovate radical concepts for a circular food and agriculture economy among a diverse group of system stakeholders. (Evans., Valsecchi., Pollastri., (2012); Evans. (2015); Evans., & Kennedy (2015); Evans., Fassi and Meroni (2016)).

The methodological framework and process remain the same across all six trials. While the specific content is nuanced for the challenge and region. For these reasons this work will focus on the action research projects conducted at two Food Tech conferences held at University College Davis, 2017 and at the University College Dublin in 2018: content of the conferences was focused on the food and agriculture domain and its relationship with emerging tech and the Internet-of-Things: attracting speakers and participants associated with this domain.

This paper will focus on the 'work' done by the participants in the real world setting. (Pawson and Tilly 1997, p60).

3 Methodology

Two, three-hour action research studies were conducted one at each of the conferences, respectively, among a diverse group of 30 eco-system stakeholders; including farmers, venture capital fund managers, academics, NGOs, Agricultural regional director, business managers and directors, food scientists and data analytics researchers and developers. The participants actively chose to participate in the study. Data was gathered in different ways by two researchers using individual and team feedback, concept development and outcomes, and participant round table.

The research question proposed to initiate ideation was framed by the goal to create food & Agriculture concepts in a circular economy such that it asked; "How can we innovate by using our knowledge, systems and Internet-Of-Things to better manage food?

3.1 The new methodological framework

The methodological framework (Figure 2) has been developed with intention to explore, support and accelerate novel business scenarios in a food and Agriculture., circular economy using a systems and design thinking approach. It has been designed to enable quick paced interventions, (Reis 2011) at the start of the design process; enable circular economy concept innovations, over a short time period, among diverse groups of participants, who may have significantly different knowledge levels and experience in circular economy and sustainability thinking and implementation either from a business, government

or individual perspective. The aim is to use this intervention to support both initiation of new ways of doing at the; a) food and Agriculture., eco-systems level and b) business transition for a circular economy (Bocken, Schuit, & Kraaijenhagen 2018).

It draws on the behavioural change work of (Dolan, Hallsworth, Halpern, King, Metcalfe & Vlaev 2012) who discuss the “increasing evidence to suggest that ‘changing contexts’ by influencing the environments within which people act (in largely automatic ways) can have important effects on behavior.”

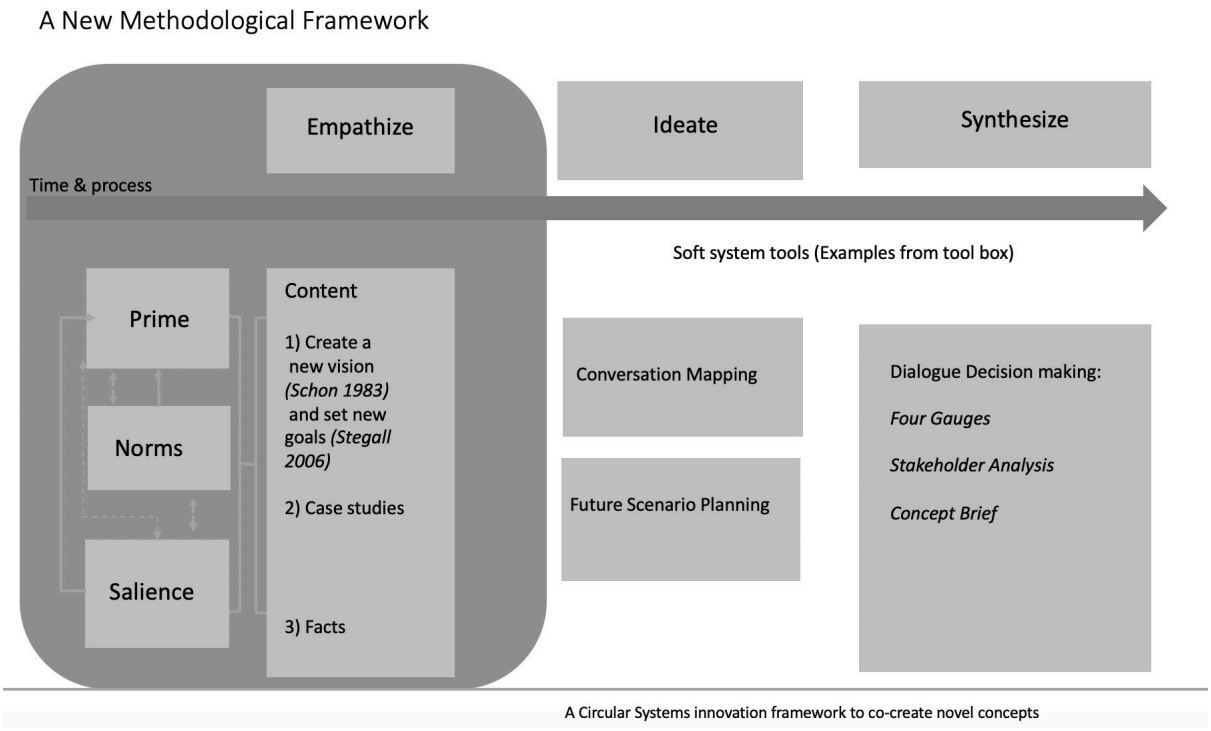

Figure 2. A New Methodological Framework to co-create novel concepts in a circular economy: Adapted from Evans (2019)

The methodological framework aims to change the context from which participants tackle the challenge, to raise automatic behavioural responses from the perspective of a circular economy context by resetting business model norms and raising salience in the potential of the challenge. In this way specific knowledge is primed in memory to make it more accessible and therefore more influential in processing new stimuli (Richardson-klavehn & Bjork 1988).

The framework consists of three parts, namely, Empathize, Ideate and synthesize. The Empathize phase is used with intention to change the context and to shift participants perspective and so their automatic decision-making references. This is achieved through knowledge sharing and takes place prior to ideation phase and aims to shift context from a linear model perspective (the current norm) to a circular model perspective (the intentional norm).

The description of how this change is achieved and then evaluated is the focus of this work.

Evaluation is made to assess the extent and ability of participants to innovate for a circular economy following the emphasize phase and again using final outcomes.

Phase 2: Ideation, captures idea plurality (Fry 2010), enabling all stakeholders to participate and contribute from their personal perspectives and unique context along the eco-system. Themes (Dorst 2011) are created and developed through teamwork and reflected on further using future scenario planning tools.

Phase 3: Synthesis is where teams are encouraged to develop their preferred concept, given the challenge, through further reflection using tools such as the four gauges (Burnett & Evans 2016) and a stakeholder roll-out plan.

In the following sections the empathize phase is explained in greater detail as the first assessment of the methodological framework is to understand if and how the emphasize phase delivers.

During the empathize phase consideration is placed on changing the norm as “the greater the influence and following of a norm in a social group the more likely others will adhere to it” (Burke and Payton-Young 2011); raising salience through the use of “stimuli that are novel, accessible and simple” as these “are more likely to register with people” (Houser, Reiley and Urbancic 2008); and priming as “behaviour is influenced by where we place our attention” (Kahneman and Thaler (2006).

This phase comprises of three parts; 1) an alternative future novel vision (Margolin 2007; Schon 83/84); 2) case studies; and 3) facts and in this way aims to change the ideation context and set the challenge.

3.1.1 An alternative future vision: The work of Schon (1983/4) is leveraged such that an alternative future vision is created based on a paradigm change from linear production processes to circular and, in this way, contributes to changing the established norm. It further helps to set the design intention and sets new goals (Stegall 2006), to encourage participant ideation for a circular economy beyond the established ‘baked in’ linear model norm (PACE 2019). The alternative future vision is created in several steps; the first considers the core principles of the circular economy in line with Stegall’s second philosophy (2006); (Lewandowski 2016); secondly builds on the circular economy through consideration of a reduction of waste. In these trials a focus is also given to by-product production and services through micro localized circular systems (Stahel and Reday 1981); and thirdly introduces the concept of data, data flow, its usage and raises questions as to its potential.

3.1.2 Case study examples were chosen to contribute to resetting norms and raising salience, chosen for their qualities of novel, accessible and simple (Houser et al 2008), and grouped under three types. For this study all examples demonstrated by-product usage with specific emphasis; a) established , long term, by-product success stories, b) Rapid success through Venture Capital funds and c) Regenerative usage (Scott 2015). Regionality was also considered with the thought to increase accessibility of the case study.

3.1.3 Facts were used to emphasize the necessity to reduce waste, including policy decisions, in-line with circular economy principles. To do this by considering the opportunities along the full system and to use product already in the system to extract greater value with the aim to reduce waste output of the system.

Together, the aim of the empathize phase is to change the context (Dolan et al., 2012) and importantly the norms, to an alternative future view (Schon 1983), “that could and should be” (Margolin 2007 p5) of the problem and raise automatic decision making with cause for

participants to consider alternative solutions to meet new goals by designing in a circular economy for sustainability.

An evaluative intervention was conducted following the knowledge sharing and before the ideation, to assess what participants found to be new and interesting; concepts, facts or examples that were brought to the foreground during this phase.

4 Findings

These are organised to answer two questions that aim to measure if and how the methodological framework met its goals to innovate radical concepts for a circular economy among a diverse group of Food and Agriculture stakeholders; 1) Did knowledge sharing meet its goals? And in what ways did it change norms from a linear business perception to a circular one; convey circular economy thinking such as to extract more value from the considered materials and energy inputs and therefore reduce: a) energy and materials entering in the system and b) waste leaving the system; 2) How did the concepts created using this methodological framework contribute to a circular economy?

4.1 Knowledge Sharing Evaluation

Knowledge sharing was found to convey a set of key elements that helped to raise automatic decision making in a circular economy among participants. Indication that norms were re-evaluated, examples proved to be salient and the alternative future vision was received as viable albeit with much work to be done and with very different time scales observed between different eco-system stakeholders.

Participants found that the alternative future vision with by-product micro systems was easy to understand and conveyed clearly the concept of a circular production system and economy whereby resources are retained in the system. Further, from this example greater value can be extracted from the resources by considering the by-product opportunities.

On reflection following knowledge sharing participants were motivated by examples of circular economy and discussed the potential of; “ micro circular systems (by-products)”; and “circular economy” as opportunities to change the way things are done; Further, dialogue indicated that the “use of data” had not been previously considered from a systems perspective and that by taking an alternative systems view there appear to be many untapped opportunities; In general policy is considered to lag behind innovation so that a conversation on “Policy as accelerator rather than laggard” inspired different ways to approach inclusion of policy makers in the design process; The indication of by-product potential at various points on the food and agriculture chain opened us a great many possibilities for consideration as one participant commented that there is “Potential to remove waste at many points”.

The case study examples were able to establish a wide variety of opportunities that raised curiosity in types of new businesses that might be created. Specifically, a case study example of ‘tomato skins and seeds to pesticide and fertilizer’, was found to highlight an opportunity to use food beyond the direct food chain. This was key to open up imagination about ‘what might be’ and of what might be needed in terms of data, knowledge and technology to be able to make potential concepts more accessible. Highlighted simple facts, such as the amount of food wasted and how this requires further resources to process and dispose, were found to stimulate the necessity and urgency for system change from linear

production to circular economy and in this way better manage the food grown in the system so as to improve the amount of grown food reaching its intended purpose. Examples were able to activate related knowledge and make it more accessible to process the challenge; as the examples demonstrated that a change has already begun.

4.2 Concept Evaluation

In this section the evaluation of output concepts is discussed in terms of method used to measure 'work' done during the process of the methodological framework that led to concept outcomes with the aim to deliver impact for a circular economy. In this way identification can be made of the potential for circular economy contributions through use of the methodological framework. The specific outcomes are not the focus of this research.

An adapted framework from ReSolve (Ellen MacArthur foundation 2013/15) is applied to assess the contribution of the output concepts in a circular economy; this includes opportunities to Regenerate, Share, Optimize, Loop, Virtualize and Exchange; with additional social values included from the work of Laubscher and Merinelli (Lewandowski 2016).

Evaluation was applied to two concepts and found that both concepts could contribute to ReSolve's 'Optimizing' classification for a circular economy: described as 'an Increase in performance and /or efficiency of products and reduce waste in production and supply chains.' That 'can be linked to leveraging big data, automation, remote sensing and steering (not necessary that product is changed or technology)'. In both cases data strategies were applied in new ways which would require technological development. These developments could offer different opportunities for eco-system stakeholders to apply information that could lead to new business models in a CE.

5 Discussion

The action research is located at the initiation of the design process (Harder, Burford & Hoover 2013) with aim to ideate and innovate radical concepts in a circular economy, over a short time frame, three hours, and has demonstrated that in these cases, conducted at a domain specific conference 'Food Tech', it was able to, during this time frame and within these conditions, change the ideation context, using the empathize phase, to shift automatic decision making and reflection toward tackling system challenges and ideating solutions with circular economy goals.

Concepts were evaluated using circular economy frameworks to assess if and how they contribute to a circular economy.

It was found that participants were successfully primed (Dolan et al 2012) to tackle the circular economy challenge by exploring the by-product food opportunities to extract greater value from the products already in the system. Two viable concepts were evaluated that were shown to contribute to a circular economy by setting goals to extract greater value from produce already in the system and in this way reduce waste exiting the system. (Stahel & Reday 1981; Ellen MacArthur 2013/15). As assessed by Resolve's framework both output concepts could contribute to 'optimize' classification, 'an increase in performance/efficiency of product and reduce waste in production and supply chain'.

Concepts demonstrated that the creative scope of ideas as a result of the methodological process, can be diverse when addressing open ended questions, at the upfront of the design

process (Sanders & Stappers 2008). A specific concept might address one defined issue and contribute to a circular economy, yet there can be alternative proposals conveyed with very different interventions to address the same issue. In this study there was diversion on type of resources to get work done, in one case an idea skewed heavily towards human labor resource intended to produce positive community impact and on the other hand a technical solution leveraging emerging tech; AI and robotics. This led to very different impacts beyond the primary goal. Impact could be measured on community, relationships, budget, timing for example. It can be said that the value of this diversity provides flexibility that may help to address regional and local needs and capabilities that may lead to a variety of choices dependent on community, availability of NGO's, type of soil and produce, or technical and robotic services; for example. Each intervention will be locally assessed in terms of its contribution to the circular economy along with, its viability, desirability and feasibility.

As a way to pre-empt an ideation process that aims to innovate in a circular economy the empathy phase was, in these conditions, found to be successful: able to change norms, prime participants and co-create concepts for a circular economy that might radically change the current system.

6 Conclusions

An exploration of a new methodological framework that influences behavior by 'changing context', the environment within which people act (in largely automatic ways), from the field of economics and psychology, crossed with emerging design practices through action research, has shown to be effective, in early trials, as an intervention to innovate concepts for a circular economy; over a short time period, among a diverse group of food and Agriculture stakeholders in a domain specific conference setting. A proposed new methodological framework uses a three-part process whereby phase 1, the empathy stage uses a set of three types of stimuli to change the context, prior to ideation, phase 2; and synthesize phase 3. It was found that the empathize phase was able to change norms, raise salience and so prime participants prior to ideation of concepts for a circular economy. The concept outputs show signs for innovation with contributions to the circular economy, following the design process. This research is in early days yet shows promise as a way for quick intense design interventions that may accelerate innovative concepts with potential to radically change an eco-system and in this way could transition business for a circular economy.

7 Limitations and directions for future

Action research by its very nature is in context and is not considered rigorous compared with scientific lab experimentation. The work can benefit from understanding the effects of knowledge sharing as presented in Phase 1 in a more controlled environment such that data can be obtained and compared for both in context real world research and in a more scientific experiment where certain external variables in real world research can be controlled.

There are only two case studies that explore the food and agriculture eco – system. Further research will explore the opportunity for the use of the methodological framework at other

interventions along the food chain and in another scenario. In this way generalization of the results can be discussed both across an eco-system and for alternative scenarios.

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Developing a Design Process Model for Cultural Creative Product: a Case Study of Table Lamp

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This study proposes a design process model for developing cultural creative products which includes four stages, i.e. association, concretisation, transformation, and implementation. The design process model was tested and applied via a realistic case study, i.e. designing a table lamp. The case study was conducted through a practice-based research approach, i.e. research through design. A series of four workshops, which were carefully organised to be a structured design decision-making process, were arranged to conduct the case study. Participants had to make critical decisions in the end of every workshop. Three different data collection methods were simultaneously applied during the workshops: observation, research diary, and interviews. It was demonstrated that the proposed design process model has the ability to facilitate the efficiency of design project and guide the participants to being identifying and using proper design methods in different design phases. The outcomes of the study show that the design process model is effective, and can be as a reference used for developing different types of cultural creative products.

Keywords: cultural creative product; design process; table lamp

1 Introduction

Facing pressure of global competition and era of knowledge economy, Taiwanese industries gradually moving towards design and branding strategy from original equipment manufacturer (OEM) and original design manufacturer (ODM). The concept of cultural creative industries is regarded by academia and Taiwanese government as one of the most important strategies to accelerate the progress of industrial upgrading and transformation. Moreover, it is also seen by industries as a good approach to increase profit and pursue innovation.

The concept of cultural creative industries was officially launched by Executive Yuan's project in Taiwan in 2002. Since then, the broad concepts of cultural creative industries has been criticised from time to time. However, it is clear that cultural creative industries have been developing very well in recent years in Taiwan. For example, many cultural creative industry parks, tourism factories, and cultural creative stores and companies are established in the past few years. We may say that the policy of cultural creative industries is a valid strategy to Taiwan.

Thus, numerous new products are launched into the related markets. Although much research has looked at cultural creative products design process and method (Lin, 2006; Chan and Lee, 2008; Wang and Hung, 2011; Shiu and Lin, 2011; Chen and Chen, 2014), very few attempts have been made to integrate decision-making approach into design process. Thus, this study develops a decision-based design process model for cultural creative product, testing and applying this design process model via a realistic case study, i.e. designing a table lamp. The case study is conducted via a practice-based research approach, i.e. research through design (Schneider, 2007). A series of four workshops were arranged to conduct the case study, and the research. The aim of this research focus on developing an efficient design process model for cultural creative products.

2 Literature review

2.1 Innovative cultural creative product

To thrive or even survive in today's competitive world, it is critical to nurture and develop innovation capabilities. Design plays a significant and important role to the creation of an innovative product (HMSO, 1995; Berends et al., 2010). A cultural creative product can be defined as an outcome of design activities in which cultural resources and elements are creatively and strategically utilised and transformed into new products (Lee, 2018). The primary purpose of developing a cultural creative product is very similar with developing any other new product, i.e. producing a competitive, innovative, and profitable new product. Product differentiation is a good strategy to fulfil the purpose (Gebauer et al., 2011). It is an effective approach to distinguish a product from its competitors on one or more basic performance or image features (Sharp and Dawes, 2001; Dickson, 1997).

However, to achieve product differentiation in today's competitive markets is difficult, especially in cultural creative markets. It is not enough to only put effort in products' forms or functions nowadays, because consumers are more demanding than ever. They are not only expecting reasonable price with good quality products, but looking for emotional values. Products could evoke positive and memorable experiences are more popular (Norman, 2005). Moreover, product has connections with cultures, community and environment could produce more emotional value to users and consumers (Shiu and Lin, 2011; Chen, 2017). We may say that embedding cultural connections in product design process is one of the important differentiated strategies in today's competitive marketplace.

It is clear that focusing on emotional connection (Norman, 2005; Suen, 2008), emotional benefits (Barrena et al., 2009), or emotional value (Desmet et al., 2001) might be more feasible and practical in the field of cultural creative products in terms of product differentiation. Furthermore, to imitate emotional features of a cultural creative product is not easy as coping the forms and functions. For example, storytelling is a good way to embed emotional feature into a product (Chiou, 2017). Experience created by a special story behind a product is not easy to be imitated.

Norman (2005) asserts that the reactions of users to design can be divided into three experience levels: visceral, behavioural and reflective. Visceral level experience in design is related to intuition. It is an immediate powerful reaction to a design and "includes the basic perceptual tasks of distinguishing objects and forming our true first impressions" (Bennett et al., 2007). The behavioural level is experienced during the use of a design. It builds upon output from the visceral level, and "focuses on issues such as readability and usability"

(Bennett et al., 2007). The reflective level refers to the higher levels of emotion and cognition. Design in this area is usually focus on analytic and cognitive skills, as Norman (2015) said: “It represents an attempt to make a design better by incorporating the experience of users and their knowledge of goals and objectives of the product or service”. To develop products with added emotional value need to carefully use the three design strategies (Norman, 2005).

Based on the innovation driven approach, product innovation can be categorised as two types: technology-push innovation and Market-pull innovation (Clark and Guy, 1998). In the design research field, there is another approach called “design driven innovation”, “design-led innovation”, “design inspired innovation”, or “design innovation”, in which concepts of new products stem from design thinking, or the design process, or the newness of new product development outcomes based on a design perspective (Cantarello et al., 2011; Rampino, 2011). Design driven innovation can be categorised into four levels (Rampino, 2011) (see Figure 1):

Aesthetic Innovation: is related to product recognition, i.e. to how much a product’s appearance differs from that of the competitors’ products.

Innovation of use: involves the degree to which a product improves or modifies its usage, perhaps adding new functions, as compared to products already on the market.

Meaning innovation: concerns the emotional and symbolic aspects of a product, i.e. what a product is able to communicate.

Typological innovation: relates to the deviation of a product from its formal archetype, i.e. a dominant design.

(Rampino, 2011)

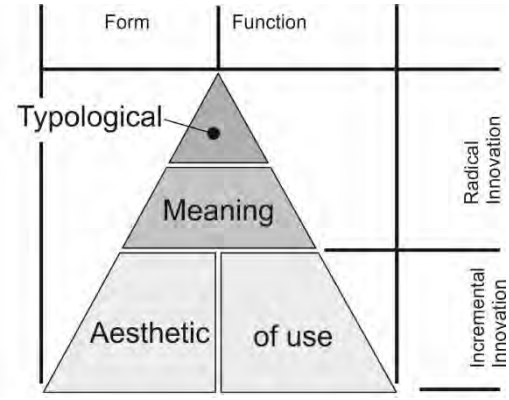


Figure 1 The innovation pyramid (Rampino, 2011)

In Rampino’s (2011) innovation pyramid, typological innovation means a dominant design which is a product’s basic architecture that has become the accepted market standard in a specific product category (Abernathy and Utterback, 1978), e.g. Apple’s ipad and iphone. It is interesting that Norman’s (2015) three design strategies for pursuing emotional value could be well integrated with and Rampino’s (2011) theory of innovation pyramid if we only look at the other three design innovation (see Figure 2). The two theories both insist on the importance of meaning in the process of experiencing products, i.e. giving reflective emotional level experience a high degree of opinion. To achieve the high level of emotional value, or design innovation, requires carefully developing products’ visual aesthetics and creativity of use. This is the key to sustainable success for cultural creative products.

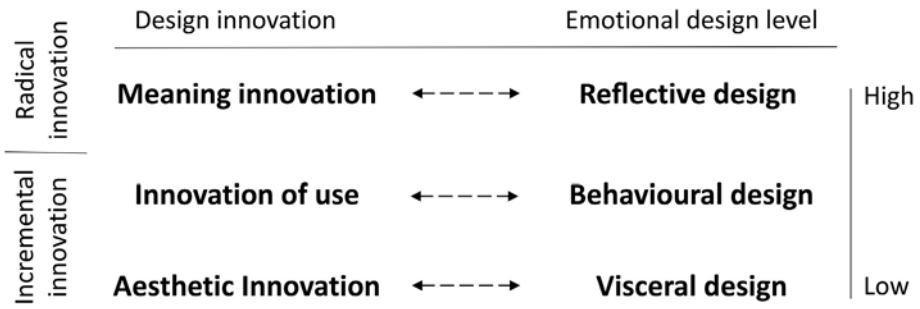


Figure 2 Design innovation and emotional design level

2.2 A design process model for cultural creative product

Since Taiwanese government promote the policy of cultural creative industries, how to develop successful products effectively and efficiently become a critical question. Thus, scholars have put forth a variety of design models and approaches for designing cultural creative products (Fan, 2004; Shiu, 2005; Lin, 2006; Chan and Lee, 2008; Wang and Hung, 2011; Shiu and Lin, 2011; Chen, 2012; Chen and Chen, 2014; Lin, 2015; Shiao, 2016; Chen, 2017). It is worth to be pointed that many of the models (Fan, 2004; Shiu, 2005; Chen, 2012; Lin, 2015; Shiao, 2016; Chen, 2017) were developed based on You et al.'s (1996) concept of image transforming design process which was on the basis of product semantics theories. You et al.'s (1996) design process included three steps (see Figure 3): association, transformation, and implementation. This design process model focuses on transforming abstract concepts to symbolic images to realistic product forms, closely linking the notion of designing a cultural creative product, i.e. creatively and strategically utilising and transforming cultural resources and elements into new products.

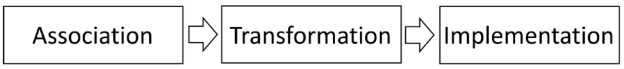


Figure 3 You et al.'s (1996) image transforming design process

To develop a successful new cultural creative product is not a singular event but a process in which a series of activities are linked, providing a framework for controlling chaos without precisely dictating each step (Gaynor, 2002; Trott, 2005; Vogel et al., 2005). Although You et al.'s (1996) design process is divided into sequential three phases, its framework does not provide designers or design teams with sufficient guidance to facilitate decisions for improving design teams' operation. Lee (2015) assert that the key to achieving successful innovation is to identify critical design decision-making points and manage the design process effectively. Roger G. Cooper (2000) proposed an extensively accepted model for new product design, namely, the stage-gate process (see Figure 4). Stage is the activities of design, and gate plays a guard rule to judge and evaluate the result of front stage is whether good enough to move to next stage. Gate severs as the quality control and Go/Kill check point in the process. The concept of stage-gate model can be integrated with You et al.'s

(1996) three steps design process, i.e. providing a framework that embedding design decision-making points for effectivity and efficiently.

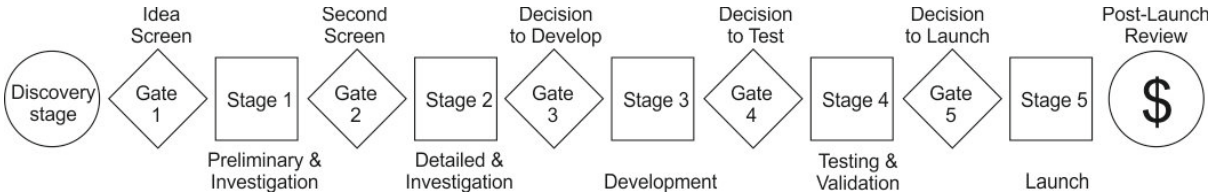


Figure 4 Cooper's (2000)stage-gate model

Design is a carrier of innovation by which creativity may occur during the design process. Aristizabal (2012) states that divergent and convergent thinking skills are both important aspects to creativity. According to Lee (2015), divergent and convergent thinking are adopted interchangeably during design process. You et al.'s (1996) design process model lacks a mechanism to manage divergent and convergent thinking. The British Design Council (2006) proposed a design process based on in-house research studying eleven leading companies: The "double diamond" design process model (see Figure 5). The model is divided into four distinct phases, Discover, Define, Develop and Deliver. It presents the divergent and convergent nature of the stages in the design process. In the discover and develop stages, the design team would attempt to find opportunities and solutions as soon as possible while deciding which solution should be progressed, and focusing on problem-solving in the define and deliver stages. The structure of double diamond design process provides a guide to invoke divergent and convergent thinking in different design stages.

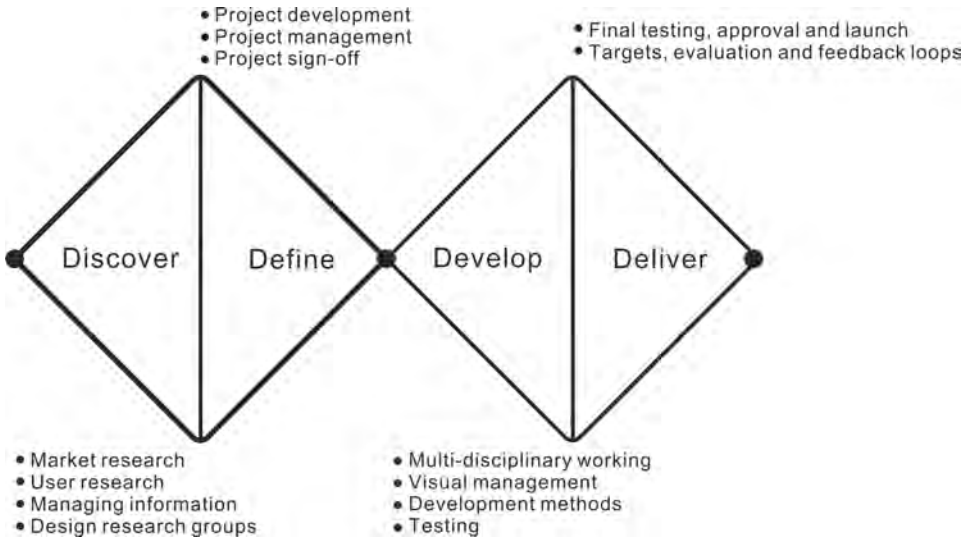


Figure 5 The double diamond design process model (British Design Council, 2006)

As mentioned above, the three design process model are all demonstrated as practical and effective models, and can be combined into one framework. Therefore, we propose a design process model based on You et al.'s (1996) image transforming design process, embedded the concept of critical decision-making points from Cooper's (2000) stage-gate process, and integrated the concept of divergent and convergent thinking guideline from The British Design Council's (2006) double diamond design process (see Figure 5). This design model includes four stages (see Figure 6):

(1)Association: is the first design stage in which the main purpose is to explore and describe experience, ideas, memory, and perception of the design subject, i.e. reflecting available cultural resources. In this stage, design process mainly relies on divergent thinking supplements by convergent thinking because this is a creativity-oriented stage. Design team discovers and reviews the important issues and true value of the design subject throughout associated techniques, such as mind mapping and concept mapping. Resulting creative ideas will be screened before starting the second stage. Furthermore, the new product's preliminary design or design specification is defined in this stage.

(2)Concretisation: is the second stage of design process which mainly relies on convergent thinking supplements by divergent thinking. In this stage, the main activity is to concretise abstract ideas, defining the design objectives by using visual image approach, such as mood board and image positioning map, to delineate, particularise, and exemplify the selected abstract concepts into some concrete representation. The design objectives usually involve some positive emotional expressions the design team would like to achieve.

(3)Transformation: is the third stage in design process which mainly relies on divergent thinking supplements by convergent thinking. In this stage, the main activity is to visualise and symbolise concepts from selected ideas and images to simplified graphics to feasible product forms via free-hand sketching or computer software. This is also the phase which has been described as a "black box" stage (Rowe, 1987; Jones, 1992; Won, 2001), in which ideas appear without evidence or identification of the source (Kurtoglu et al., 2010).

(4)Implementation: is the final stage of design process which mainly relies on convergent thinking supplements by divergent thinking. In this stage, the main activity is to develop selected product concepts into products or real scale prototypes. Product form details, structure design, colour plan, and material selection are all finished in this stage. In some situations, design team also needs to consider issues of production.

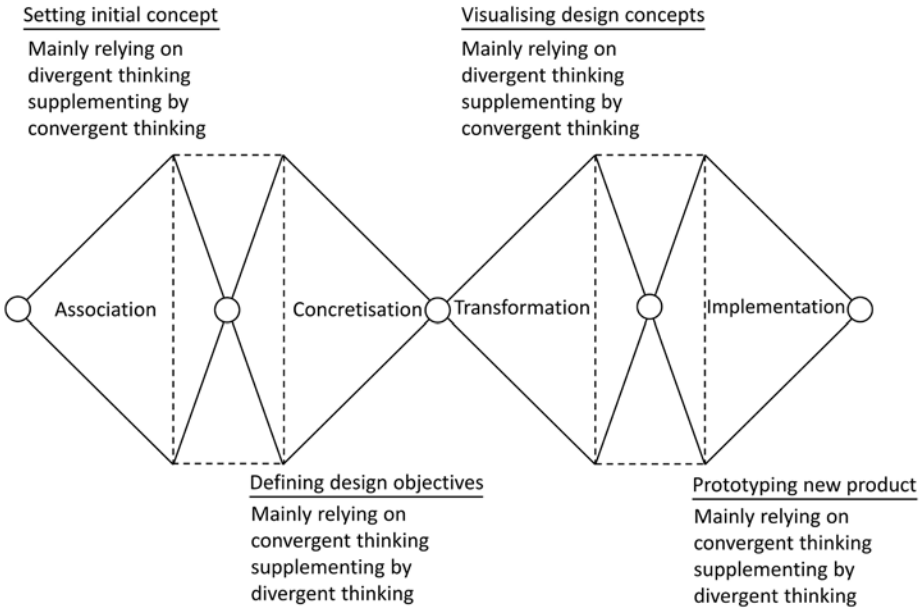


Figure 6 the four stages of design process of this study

3 Methodology

Based on research through design approach (Frayling, 1994; Zimmerman et al.2007), an empirical study was designed to implement and assess the proposed design process model. Literature review and case study are employed as main research methods. The literature review focuses on design process model, the relationship between innovation and cultural creative product. The case study was conducted via a series of four workshops at a university in north Taiwan to understand the participants' experience of the design model and to explore themes that will underpin the future development of the proposed design process model. Twenty novice designers as participants attended the workshops to develop and prototype a cultural creative product, i.e. a table lamp, based on four design stages. According to the four sequential stages of the design process, the four workshops were carefully organised to be a structured design decision-making process. Each workshop has its specific outcomes. Participants had to make critical decisions in the end of every workshop, i.e. critical decision-making point. Thus, data collection was conducted during the workshops alongside several other techniques, such as a research diary, observation and interviews. Finally, analysing and synthesising the data for refinement that completed the current model.

4 Case study: from ocean image to a cultural creative product

In this section, a new product development project using the proposed design process model in a series of workshops is shown as an example case. Based on the four stages of the design process model, four workshops were held in sequential weeks in Keelung, Taiwan as the case study to prove the practicability of the model. Twenty participant design team members were all novice designers, i.e. year 3 students, from Taiwan Ocean University. The assignment give to the design team was "developing a cultural creative product inspired from kelp, analysing and applying image of ocean to product design". In addition, this new product would be used in a small kelp museum for the purpose of public education. In the following sections, the case study is reported to document the details of the design process.

4.1 Association stage: setting initial concept

4.1.1 Symbolising ocean image to evoke environmental sustainability

Taiwanese, including the aboriginals and the ancestors from the Mainland China, have a long relationship with ocean and believe they have the gene of ocean in their bloods. Taiwanese are proud of their ocean culture. Thus, Taiwanese called ocean "Mother" because it provides plenty of natural resources. However, it is over exploited, and has been sacrificed for the demand of economy growth in the past fifty years. Everyone knows the fact that ocean pollution is getting more serious, and the marine life is also getting more endangered. However, we are still damaging the ocean today.

For example, Taoyuan Guanxin algal reef will be jeopardized by Chinese Petroleum Corporation's (CPC) new liquefied natural gas (LNG) terminal (United Daily News, 2018). Many scholars and activists revealed that the location of CPC's new LNG terminal will absolutely damage the algal reef and its ecosystem, but the government does not stop the plan and is still evaluating the cons and pros (Lin, 2018). Moreover, according to their research, Lin (2018) found that not all the residents care about the controversial issue and their environment. It is possible that they may not understand the value of Guanxin algal reef, or they perhaps are used to receive feedback money from CPC (Lin, 2018).

It is clear that we need to put more efforts on marine conservation education. Even the Taiwanese government launched “An Overview on the Ministry of Education’s Marine Education Policies” for improving the overall quality of the population in teams of ocean consciousness in 2012. Many Taiwanese are not conscious of the importance of sustainable ocean environment. Facilitating marine education is not only the government’s responsibility, but a responsibility of all citizens. Thus, the design team hopes to contribute on increasing the consciousness of ocean sustainability via developing a new product with symbolistic ocean images by which users might reflect on ocean sustainability issues in their daily life when using the product.

4.1.2 Developing a table lamp using kelp as material

Kelp, also called algae, is one of the important ingredients in Taiwanese cuisine. It is very popular in Taiwan because it is testy and heathy, and its reasonable price. The design team utilised free association method to seek innovative opportunities and initial ideas during the very beginning stages of the design process in terms of kelp and ocean related information. Divergent thinking is dominant in the association stage when exploring initial ideas, providing as much as possible information for setting the initial framework of the new product. In this stage, the design team discovered a connection between kelp and sunlight which presents concepts of healthy and energetic. Therefore, the design team decided to develop a table lamp which using kelp as one of its materials or components by which users can be inspired by the appearance of the lamp and the interaction effects triggered by switching on the light. Mind mapping technique was used during this workshop, helping design team to exploring, seeking, and recording ideas (see Figure 7).

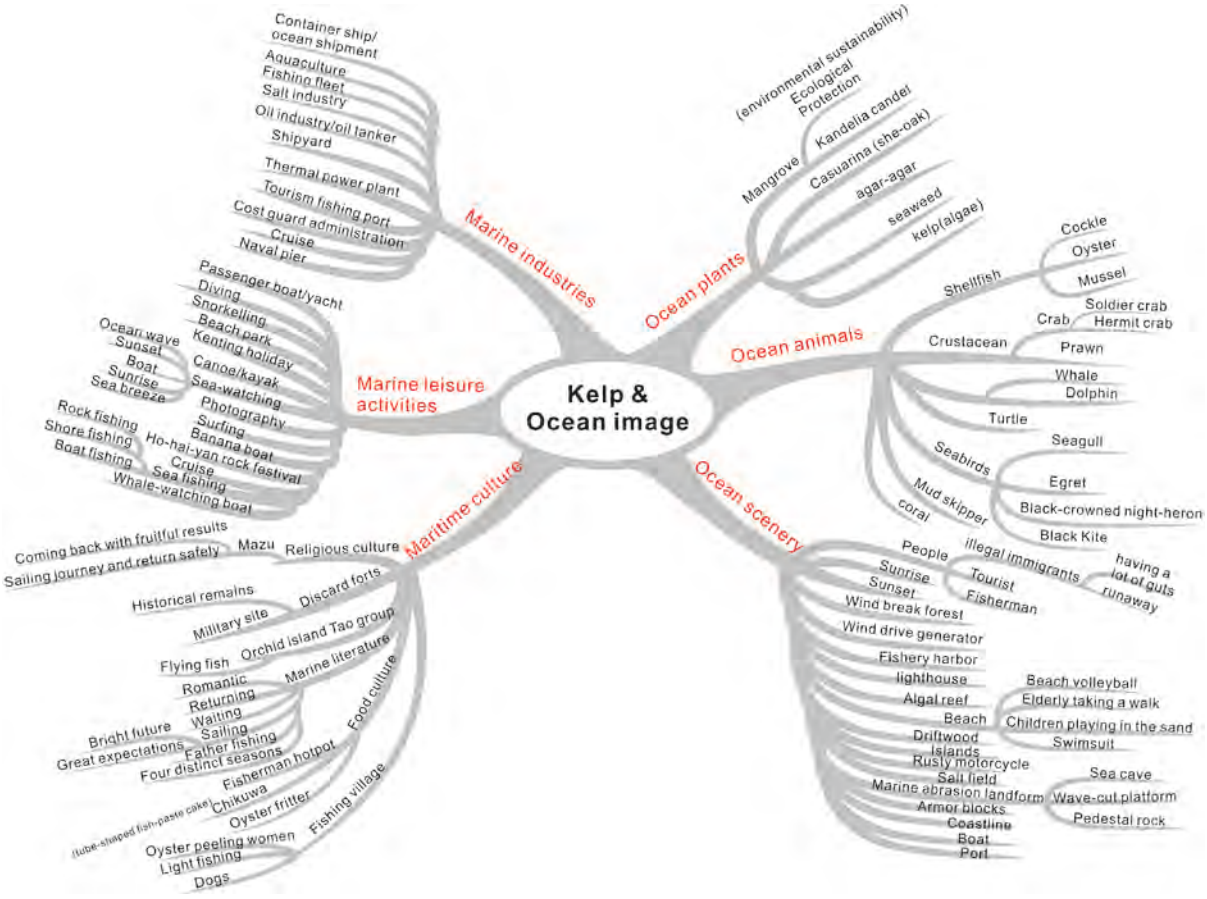


Figure 7 Using mind mapping techniques to exploring, seeking, and recording ideas

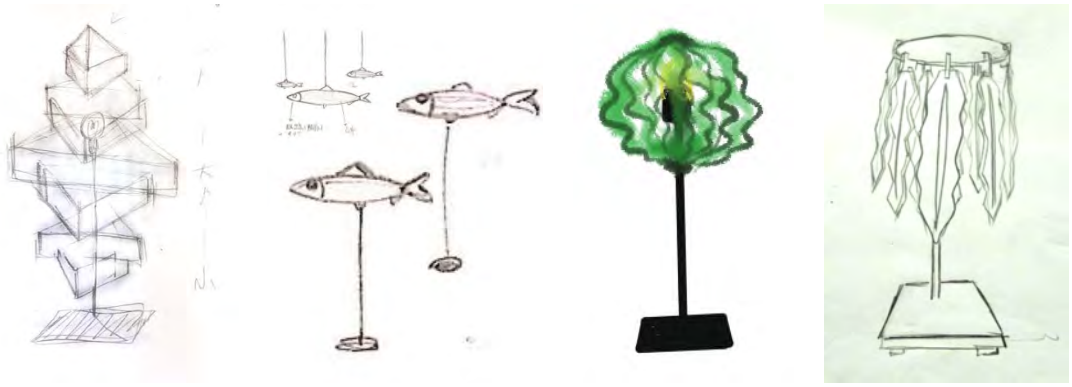
4.2 Concretisation stage: defining design objectives

Convergent thinking is dominant in the concretisation stage as the main activities is defining design objectives by concretising abstract ideas into more solid media. After analysing the ideas generated from the previous stage, the design team found three key concepts which have positive association to users and suitable to the direction of the design project as follows: hopeful, sustainable, and healthy leisure. Then using the three concepts as themes to compose mood boards for the design team's reference in the following stages (see Figure 8). The purpose of the mood boards is to inspire the design team to develop more creative and feasible ideas in the transformation stage. The three positive emotional terms were also the goal to achieve, i.e. delivering the emotional connections to users.

Figure 8 Using mood boards for inspiration

4.3 Transformation: visualising design concepts

This is an important stage in design process in which abstract ideas are transformed into concrete forms. The design activities is complicated and could be a iterative process in which divergent thinking and convergent thinking frequently interchange. The design team used their presentation skills to visualise and symbolise concepts from their mind which related to the three key concepts (see Figure 9). In the meantime, they also need to consider the basic structure of the product, possible way of manufacturing, and which parts of the product would be formed by kelp materials etc. In this very creative design activities, pursuing the core aim of the design project, i.e. using kelp as parts of materials, is a very important criterion, but feasibility and aesthetics are also important.



Lee(2018) Lin(2018) You(2018) Shiu(2018)

Figure 9 Using presentation skills to visualise design concepts

4.4 Implementation: prototyping new product

Convergent thinking is dominant in this stage. The implementation stage can be divided into two sub-stages. In the first sub-stage, the design team focused on details design and modifying structure by using 3D computer software. Simulating the new product is an important task in this sub-stage (see Figure 10). In the second sub-stage, prototyping the new product is the main task. In this sub-stage, the design team needed to make the final critical decisions by verifying aesthetics of the form design and feasibility of the structure. Finally, four table lamps were selected to be displayed in a small kelp museum for the purpose of public education (see Figure 11). The four lamps all adopted kelp as partial materials which is symbolic of healthy. The light can be seen as a symbolic of positive and hopeful. The forms of the lamps are delightful. They do not only create aesthetic pleasure but evoke users' conscious of the importance of sustainable ocean environment especially when users turn the light on.

Lee(2018) Lin(2018) You(2018) Shiu(2018)

Figure 10 3D Computer software presentation

Lee(2018) Lin(2018) You(2018) Shiu(2018)

Figure 11 The prototypes of table lamps

5 Discussion and Conclusions

This study developed and tested a design process model which based on You et al.'s (1996) image transforming design process, embedded the concept of critical decision-making points from Cooper's (2000) stage-gate process, and integrated the concept of divergent and convergent thinking guideline from The British Design Council's (2006) double diamond design process. The proposed design process model includes four stages: association, concretisation, transformation, and implementation. In the end of each design phase, a critical decision-making point is set to facilitate and expedite design process. In order to verify the feasibility of the proposed design process model, a series of four workshop were held to develop a kelp table lamp as the case study. It was demonstrated that the proposed design process model has the ability to facilitate the efficiency of design project and guide the participants to being identifying and using proper design methods in different design phases. The outcomes of the study show that the proposed design process model is effective and can be as a reference used for developing different types of cultural creative products, and furthering educational training. It was evident that the workshops were fruitful when participants keep adopting the method for other design project.

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Diagram of Modern Definitions of Craft: The Figurative Behaviour of Craft in the Japanese Folk Craft Movement

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UNESCO's report has extended the definition of craft from 'visual arts' to the 'design and creative services domain' since the 2000s. The scope of the definition is extending further with industrial or economic development of producing area. However, we can also focus on the figurative behaviour of craft that induce civil participation and small and grassroots activities in local communities in Japan. Such behaviour can be attributed to Nomin-bijutsu (hereinafter called 'the Peasant Crafts movement') that began in 1919. This article discusses the potential of craft from the following two perspectives. One is the situational presence of craft, in which 'public' can be equated with 'recreation, education, and labour', 'visual' with 'aesthetics, simplicity, and expression', and 'domestic' with 'lifestyle, interior, and housework'. The other is the historical presence of craft, described as 'the Peasant Crafts movement', 'Yanagi's classification', and the 'enculturation of administration'. The former illustrates the potential of craft in the community. The latter includes the former in its definition of craft. Therefore, we can define the figurative behaviour of craft in Japanese theory and the system of craft. For example, although Yanagi's classification, which was published by art critic Muneyoshi (Soetsu) Yanagi (1889-1961) in 1928, theoretically separates 'folk craft' into 'guild-oriented (creative crafts)' and 'business-oriented (industrial craft)', this article clarifies that the Peasant Crafts product is a synonym of the concept of 'folk craft' in the context of unification of 'guild-oriented (creative crafts)' and 'business-oriented (industrial craft)' folk craft. It also indicates that the Peasant Crafts movement is opposed to the enculturation of administration in the context of change from village scale to city scale.

Keywords: peasant art; community; arts and crafts; enculturation

1 Introduction: crafts as small, grass-roots, and civil-participation activities

This article aims to clarify the contemporary definition of local craft in Japan. We can generally classify Japanese craft into two categories. One is craft as traditional visual art. It is designated as the technique of a superior craftsperson by the government. The other is craft as contemporary and simple products developed by local industry. For example, the farmer would be defined by art history in Japan. The latter category of craft would be defined by product development in a producing area. The Ministry of Economy, Trade and Industry (METI) supports the latter with the promotion enterprise such as The Wonder 500 project that selects crafts across Japan. It also has come from the fact that rapid economic growth left Japanese people materially satisfied but spiritually unsatisfied.

There is craft that cannot be classified by the above perspective. These are local crafts that should be defined by small, grass-roots, and civil-participation activities. Craft is recently expanding as culture in Japan. It is different from the *Maker Movement* defined by C. Anderson (1961-) or the indies movement defined by online marketplaces such as *Etsy*.

This article puts a spotlight on the Japanese peasant crafts movement of Nagano prefecture, *Nomin-bijutsu* (hereinafter called “the Peasant Crafts movement”), as a good example for defining local craft. It began as a side activity of peasants during winter in 1919 and is still active now. Although the movement has produced handmade crafts such as a small wooden figurines, boxes, and dishes [Figure 1], its manufacturing scale has been recently shrinking. However, we can review the movement as an achievement of design thinking that originated in local areas. This article talks about elite stances toward rural making and makers, and not rural making itself, in order to clarify the figurative behaviour of crafts.

Figure 1. (left) Wooden figure called koppa-ningyo (timber off-cuts doll); (right) Wooden dish with the carving of a duck. There were various styles of design during the Peasant Craft movement.

2 Literature review: development of the definition of craft

Previous articles have discussed the design value of the Peasant Crafts movement since the 1970s (Japan put an Act on the Promotion of Traditional Craft Industries into effect in 1974).

Tuzuki (1974) regarded it as ‘one of the design theories that tried to integrate fine art and applied art’. Works of the Peasant Crafts movement were positioned as early industrial designs. However, the article focused on aesthetical classification as fine art or applied art. We cannot constructively define the works of the Peasant Crafts movement as modern crafts from this perspective.

Yamaguchi (1995) contributed to the above issue in the context of the promotion of a village. She regarded the Peasant Crafts movement as internal activities that encouraged village life. Governmental policies for side activities of the village industry or the foundation of the Industrial Arts Institute led to the development of the export industry of Japanese crafts. This was an administrative project to commercialize Japanese folk art. However, should we regard the activities of peasants as part of the official movement? Doing so might ignore the fact the peasants’ subjectively or voluntarily planned crafts.

Tsujimoto (2005) responded to the above question. She pointed out the philosophical relation between the English Arts and Crafts movement and the Japanese Peasant Crafts movement. The design of the crafts can be regarded as a reflection of the value of their handicrafts. However, this conclusion takes back the Peasant Crafts movement to a retrospective preference for the medieval ages and further away from defining modern crafts.

Banks pointed out, 'Indeed, critics now suggested that even in more advanced, globalised economies, characterised by various kinds of "post-industrial" work, processes appear to resuscitate the condition of craft production' (Banks, 2007). When reviewing the Peasant Crafts movement today, we must innovatively define it in terms of modern crafts. Then, we can classify the changes in the definition of crafts into three developments as follows:

2.1 Development (1): conceptual extension as transversal domain

The International Symposium on 'Crafts and the International Market: Trade and Customs Codification' defined crafts as 'those produced by artisans, either completely by hand or with the help of hand-tools or even mechanical means' (UNESCO, 1997). This definition focuses on 'the special nature of artisanal products'. This definition is stereotypical but popular among us. We believe the essence of crafts 'derives from their distinctive features, which can be utilitarian, aesthetic, artistic, creative, culturally attached, decorative, functional, traditional, religiously and socially symbolic, and significant' in this case. However, *the 2009 UNESCO Framework for Cultural Statistics* revised the definition later as follows: 'Many crafts objects are produced industrially…Contemporary crafts are not in *Visual Arts and Crafts*, but are included in Domain F, *the Design and Creative Services* domain' (Pol, 2009). The Domain F is a category of that 'covers activities, goods, and services resulting from the creative, artistic, and aesthetic design of objects, buildings, and landscape' (this domain includes Intangible Cultural Heritage, Archiving and Preserving, Education and Training, and Equipment and Supporting Materials). Crafts should be presented as a transversal domain now. For example, the skills to manufacture crafts are intangible cultural heritage. We can see cultural value in the elaborate motion of hands and arms manufacturing crafts as performing art now.

Value lies only in skilful artisans; it does not focus on whether people belong to small, grassroots, or civil-participation activities.

2.2 Development (2): sociological extension with craft-community and craft-association

Creative Economy Report (UNESCO, 2013) introduces two notable facts: one is that craft had already developed as a cultural industry in Africa, Arab states, and Asia-Pacific, etc., the other is that craft manufacturing forms each communities' cultural industry in the local economy. Craft manufacturing put the labour force together to create profit and employment in economically developing areas. This report also pointed out an issue to realise craft-community in the creative industry. For example, a nongovernmental body, the Vietcraft Association of Handicraft Exporters said integrating design thinking into the craft value chain remains an uphill battle because of a lack of resources and knowledge. Policymakers need greater capacity to understand how individual creative workers and small cultural enterprises operate, and closer links need to be built between them and creative workers. In this context, as there are no independent sub-regional cultural agencies, professional associations have an important role to play as they are familiar with the assets, needs, and possibilities of each industry branch.

However, past reports might exaggeratedly regard craftspeople as high-level specialists or expect them in strategic, general, and cross-sectional roles. An artisan of the Peasant Crafts movement, Toshiharu Ozawa, vice-president of the above NPO enjoys talking with people at a citizen's workshop on craft-making. Open and liberal relationships between him and other citizens there makes us aware of the fact that he is a part of the community. Although his behaviour might be small, grass-roots, and not innovative, his activity is important to promote craft within the community. Therefore, we would also need modern definition on craft that can explain this perspective.

2.3 Development (3): discourse extension with socio-technical industry

Karin Hansson introduced the complex roles of design with designers who work with vulnerable craft communities in India through NGO founder Annapurna Mamidipudi's interview with a designer. The designer mediated the tension between traditional craft economies and capitalist markets. Mamidipudi pointed out that 'three positions of designer on a scale of epistemologies, ranging from "intervention", where the designer enables economic development in a crafts community; to support of "inter-action", where craftspeople actively participate in socio-technical networks of production; to "mediations" in which craftspeople are treated by the designer as experts in their own right' (Hansson, *et al.*, 2018). Discourse of craftspeople is equivalent to designers and policymakers who approach the local craft as mediators.

However, the stakeholders are not only the designers or craftsmen, but also the villagers and peasants; their integration forms a local community. We should summarise the above developments as the interface between traditional idioms and contemporary society. Therefore, we can regard crafts as innovative representations of the local community.

3 Research aims

This article focuses on the figurative behaviour of crafts that induce civil participation and small and grassroots activities in local communities in Japan to define modern crafts, another development in producing areas. We can not only observe the figurative behaviours of craft but can also place the behaviours in the context of Japanese theory and the system of craft to understand the extended definition of craft in local communities of Japan.

4 Research methods

This article arranges the potential of craft into the following two perspectives. One is the situational presence of craft, in which 'public' can be equated with 'recreation, education, and labour', 'visual' with aesthetics, simplicity, and expression', and 'domestic' with 'lifestyle, interior, and housework'. The other is the historical presence of craft, described as 'the Peasant Crafts movement', 'Yanagi's classification', and the 'enculturation of administration'. The former illustrates the potential of craft in the community. The latter includes the former in its definition of craft. Therefore, we can define the figurative behaviour of craft in Japanese theory and the system of craft.

We might question why this article will not deal with the history of Japanese craft before the modern age. The major premise to study the history of Japanese craft is the fact that the definition and word of 'craft' did not exist in Japanese philosophy. The present Japanese term, *kogei* (craft), was either translated from Western terms or artificially created at the beginning of the Meiji period (1868-1912) in response to modernisation and Westernisation.

The term previously used, *gigei* (technical art), implied both the concepts of ‘fine art’ and ‘craft’ (Kikuchi, 1994). When crafts have been exaggeratedly Japanese for foreign preference, namely, *Japonism*, the definition of craft greatly developed alongside business-oriented industry and utilitarianism for export. As a result, the definition of *kogei* formed to encompass a broad concept ranging from technology, science, and engineering, to manufacturing and crafts since the 1880s.

This article focuses on the definition that does not come from encompasses technology, science, and engineering. Therefore, it also regard present the Peasant Crafts product as part of the post-industrial transition of craft.

5 Situational presence of the Peasant Crafts movement

A painter, Kanae Yamamoto (1882-1946), who studied abroad in Paris after graduating art school, established the Peasant Crafts movement. Yamamoto collected wooden toys from Russia during his return journey to Japan. It was an inspiration for the movement. Russia had a rich wooden object culture because the wood manufacturing industry could survive in long and severe winters.

Yamamoto described, ‘there is an area called Talashkino in Smolensk Oblast, Russia. The interesting art movement was occurring there about twenty years ago. Statues, paintings, embroideries, weavings, dyeing, and ceramics made peasant’s houses, furnishers, and clothes beautiful…This movement seems to be in response to art movement famous for English William Morris’. (Yamamoto, 1924) Yamamoto applied this experience and knowledge to the Peasant Crafts movement. Peasants imitated it at the beginning of the movement. This manufacturing state was regulated by the workshop facilities of the village. Peasants used woodworking machines such as a hollow chisel mortise, plainer, and turner in the 1920s (Kangawamura kyodo kenkyukai, 1973).

5.1 Situational presence: ‘public’ can be equated with ‘labour, recreation, and education’

When the movement established a Tokyo branch office in 1927, Yamamoto wrote about his trouble as follows: ‘a thinker looks at the properties of creative labour and the spread of subline-value to encourage themselves. [However] artists are not interested in running it as a business with an industrial mission even though they focus on the name of the Peasant Crafts movement with admiration for its primitive design and skill. On the contrary, they showed his feeling that was not gladdened by the appearance of such arts’ (Yamamoto, 1921). A novelist, Roan Uchida (1868-1929) summarised this trouble in the movement, ‘simplicity and plainness in the life of the Peasant Crafts movement would disappear if they were educated’.

However, Yamamoto and Uchida would overlook the fact that the peasants awoke the concept of recreation. The peasants would be excited by Western methods of arts, crafts, and its culture. A peasant said, ‘to learn carving made my life brighter…I came to realise the individual beauties in the looks of peasants who worked in the field’(Yamaguchi, 1995). The Peasant Crafts movement did not only give job to peasants. He also built a wooden laboratory to train peasants to produce crafts and to develop them with semi-Western style architecture. Yamamoto also invited professional artists from Tokyo to train the peasants. They were young and ambitious sculptors such as Hakurei Yoshida (1872-1942), Goro Kimura (1899-1935), and Tsuruzo Ishii (1887-1973). Ishii would become an authority on

sculpture in Japan and worked as a professor at Tokyo University of Art and Music. The peasant learned how to produce a small wooden figures from them. Therefore, the peasants were basically educated with modernist sensibilities. The simple and plain design of wooden figures comes from this modern and academic education. They also held a culture festival in the village to enjoy classical music by J. S. Bach, drama by J. A. Strindberg, and lectures by Yamamoto and an oil painter, Kazumasa Nakagawa (1893-1991), etc. Craft made their life active. The Peasant Crafts movement was placed in the cultural motivation of the village-scale. We can regard this feeling as awakening to peasant art. The Peasant Crafts movement would provide fresh air to the conventional society of *Kangawa* village. It would bring cooperation, liberal arts, and identity to the peasants.

5.2 Situational presence: 'visual' can be equated with 'aesthetics, simplicity, and expression'

Russian contemporary aesthetics were popular in Japan. For example, Tolstoy's *What is Art* (1897) was published in a Japanese version (1931). 'Artistic activity will then be accessible to all men. It will become accessible to the whole people, because, in the first place, in the art of the future, not only will that complex technique, which deforms the productions of the art of to-day and requires so great an effort and expenditure of time, not be demanded, but, on the contrary, the demand will be for clearness, simplicity, and brevity—conditions mastered, not by mechanical exercises, but by the education of taste' (Tolstoy, 1897). The Peasant Crafts movement was avant-garde in craft with such philosophy; it was a great achievement of amateurs in this context. The peasants could produce the crafts within half of a year. They began to imitate Russian crafts such as a bowl, paper knife, or shelf, etc. with wooden figures. They were practical and daily goods. The wooden figures expressed the true picture of peasants who worked in the field. They respected the popular fact that they were peasants; they were labours. Yamamoto took a little wooden shelf from Russia that had a relief of the Russian fairy tale, *Finist the Falcon Prince*. The peasants changed the relief on the shelf from prince to Japanese cherry blossoms. Its flowers are elaborate and realistic in comparison to the Russian ones. There is also vertical lined pattern of carving behind them. The language of cherry blossoms is 'purity', 'nice beauty', etc. in Japan. The change is not only its motif but also its expression. Peasants who designed this shelf changed the imaginary motif for children to a sophisticated craft for adults.

5.3 Situational presence: 'domestic' can be equated with 'lifestyle, interior, and housework'

The movement marked the introduction of a new lifestyle into village life. Yamamoto wrote his plan for the Peasant Crafts movement *kengyo no shuisyo* (The prospectus for the foundation of the Peasant Crafts movement, 1919). It said, 'our goods list covers wooden toys, carved stationary, decorative trays, embroidery, dyed table cloths, cushions, cloth for bags, simple ceramics, chairs, tables, little furniture like a book shelf, and wallpaper'(Yamamoto, 1919). We can read three representations of this description. Firstly, he imagined a the Peasant Crafts interior with a Western lifestyle. The above products were rare in conventional Japanese-style interiors. The school, bank, and theatre only apply the Western style to architecture and its furnishings through early modernisation of the 1920s. The movement aimed to establish a modern lifestyle with Western-style product design to change their tradition and vernacularism. Western design means modern for them, in this case. The peasants of *Kangawa* village were more intellectual and modern. Secondly, the above description seems to look over a room where the Peasant Crafts products were here

and there. We should focus on the collective preference in it. This ‘profusion, piling high are clearly the most striking descriptive features’ of consumer society (Baudrillard, 1970). The movement truly projected luxurious dream more than the sum of Western products. The Peasant Crafts movement unveiled the fact that the peasants held pleasure-seeking consumer minds. Thirdly, we know the fact that this interest in interiors came from housework, a modern theme of philosophy. G. Bachelard described this point in his book, *The Poetics of Space* as, *‘*Objects that are cherished in this way really are born of an intimate light, and they attain to a higher degree of reality than indifferent objects, or those that are defined by geometric reality. For they produce a new reality of being, and they take their place not only in an order but in a community of order. From one object in a room to another, housewifely care weaves the ties that unite a very ancient past to the new epoch. The housewife awakens furniture that was asleep*’*. (Bachelard, 1958). The Peasant Crafts movement would publicly put the spotlight on the housewife as keyperson in the interior.

6 Historical presence of the Peasant Crafts movement

Although the Peasant Crafts movement developed in 1920s, it also experienced a standstill during World War II in 1940s, high economic growth since the 1950s, economic stagnation since the 1990s, and the development of the domestic culture administration since the 2000s. This article focuses on the following two events featuring local crafts to include the situational presences above in the modern definition of craft in Japan.

6.1 Yanagi’s classification

A philosopher, Muneyoshi (Soetsu) Yanagi (1889-1961), defined craft with following diagram in his book, *Kogei no michi* (The Road of Craft, 1928):

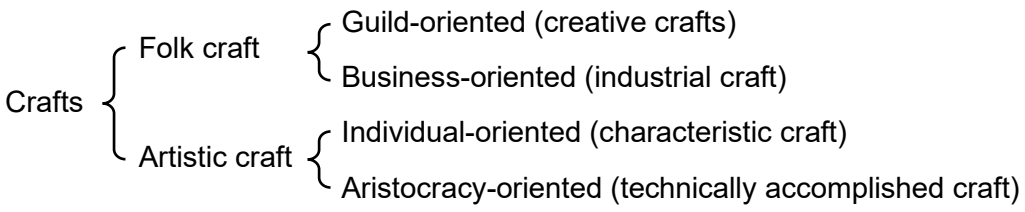

Figure 2. Yanagi’s classification of modern craft (1922)

Yanagi’s philosophy offered a matrix of the definition of craft at that time. He classifies the definition of craft into ‘Folk craft’ and ‘Artistic craft’. The latter means craft as fine art. ‘Aristocracy-oriented’ craft included products for export that showed exaggerated Japanese taste for foreign preference, namely Western *Japonism*. *Kiriu-kosho-kuwaisha* and *Yamanaka-shokai* were leading companies that produced and exported elaborate craft.

The definition of ‘Folk crafts’ comprises ‘Guild-oriented (creative crafts)’ and ‘Business-oriented (industrial crafts)’. The latter indicates the fact that the concept of folk craft includes industrial design. They were not conceptually separated at this time. For example, some early modern design of chair often applied conventional bamboo-weaving from the 1930s to 1940s. Because craftspeople were strongly inspired by Scandinavian design, they substituted the word *kurafuto* that came from *craft* for *kogei* in Japanese (Hida, 2004). They truly positioned themselves as opposites to artistic craftspeople who seemed be far away from actual life. The *Kurafuto* school as an artist group was mainly active from the 1970s to 1980s.

Craftspeople of this school have held design exhibitions since 1953. Their themes supposed products for actual life such as ‘things for children’, ‘flower vase’, ‘lamp shade’, ‘tableware’, ‘crafts for life we can buy at 1,000 yen’, etc. It showed modern definition of crafts with practical design, tasteful material textures, and elaborate details of Japanese tradition. Craftspeople of local industries across Japan followed this definition to design their products because its design balances between mass-production and added value from being handmade.

Banks pointed out, ‘Arguably, under individualised conditions, we can identify something of a shift back to “authentic” forms of production (local, traditional, “natural” or “organic”) and a revalorisation of craft production amongst cultural producers as they seek out the benefits of these internal rewards’ (Becker, 1982; Lash, 1994; Banks, 2007). This point is true not only for craft in the post-industrial age but also for craft in the early industrial age of Yanagi’s classification. This genealogy is still continuing. As mentioned above, the Japanese METI selects the best local crafts across Japan to promote crafts through enterprises such as The Wonder 500.

6.2 ‘enculturation of administration’ policy

This definition of craft extended with the local administration climate in the 1970s-80s. The climate called ‘enculturation of administration’ was popular in local areas in the context of critiquing homogeneous and utilitarian management of high economic growth. Osaka Prefectural Government implemented a culture promotion section in 1973. Hyogo (1974), Saitama (1976), and Kanagawa (1976) also initialised it later. Tadao Kiyonari and Satoshi Morito arrange ‘enculturation of administration’ as ten projects: to establish a laboratory centre that researches and develops local products, to found a museum that provides information on the tradition of the local area, and to establish a school that trains the people in craftsmanship or opens courses on local culture, etc. (Kiyonari and Morito, 1980). The definitions of such policy influenced the scenery of producing areas: traditional local design of products applies to a wider context of architecture. Craft has administrative properties in this climate. The Japanese National Land Agency defined culture activities as follows in *Research on the state of local culture leadership and its training method* (1982): (1) activities that plan research, study, conservation, and training local history, tradition, entertainment, nature, cultural heritage, and scenery; (2) creation and performance of citizen visual art, literature, music, plays, and movies, etc.; and (3) learning the cultural value of citizen study and mastery of folk song, reciting Chinese poems, tea and flower arrangement, dance, dressmaking, and language (Uno, 1983).

Local governments came to respect the importance of civil participation to decide policy on local culture. According to Japanese Cabinet Office research on cultural activities of the Japanese, we can see the change in the civil participation as follows (Table 1):

Table1: Have you made an artwork or art performance within the last year?

	1987	1996	2003	2009	2016
Creation experience in literature, music, and visual art, etc. (%)	3.8	4.5	4.7	7.4	6.8
Participation in local festival or event (%)	-	-	-	10.1	13.8
Not particularly (%)	81.7	82.1	83.5	76.1	71.3

Source: This table arranges the results of five research projects entitled 'Opinion polls on culture' from 1987 to 2016.

The number people who made artwork in the last year is increasing in Japan. Its largest category of 'artwork or art performance' was participating in a local festival or event. 'Creation experience in literature, music, and visual art etc.' would go along with 'Participation in local festival or event'.

UNESCO observed the 'cultural participation' in policies and trends in cultural industries as follows: 'Thus, cultural participation includes cultural practices that may involve consumption as well as activities that are undertaken within the community, reflecting quality of life, traditions, and beliefs. It includes attendance at formal and for-fee events, such as going to a movie or to a concert, as well as informal cultural action, such as participating in community cultural activities and amateur artistic productions or everyday activities like reading a book' (UNESCO, 2009).

Craft produces recreation, education, and hobby content in daily life with its manufacture, appreciation, and collection.

7 Conclusion

7.1 The Peasant Crafts movement, Yanagi's classification, and 'enculturation of administration' policy

We can include the 'situational presence' of craft above in the definition of craft, as shown in Figure 2.

(Comparison of Phase 1 with 2) Although Yanagi's classification arranges the definition of local craft into some categories, the Peasant Crafts products unifies 'Guild-oriented' with 'Business-oriented' as folk crafts. They are creative crafts with an apprentice system but industrial craft for peasants' side work is as mentioned above. The Peasant Crafts products seem to have this dual character from such viewpoints as Yanagi's classification. User-oriented definitions of Peasant Crafts products would be latent under Yanagi's classification (that is, it displays maker-oriented definitions).

(Comparison of Phase 1 with 3) The 'enculturation of administration' promotes craft with workshops or civil participation. However, it does not actually deal with the internal, subjective, specialist, or internal dynamics seen in the 'situational presence' of the Peasant Crafts lifestyle. Therefore, the Peasant Crafts movement is opposed to the enculturation of administration in the context of change from village scale to city scale. Although the 'enculturation of administration', as a policy, made civilian life cultural, the Peasant Crafts movement respected the value of peasants' lives as an irreplaceable culture.

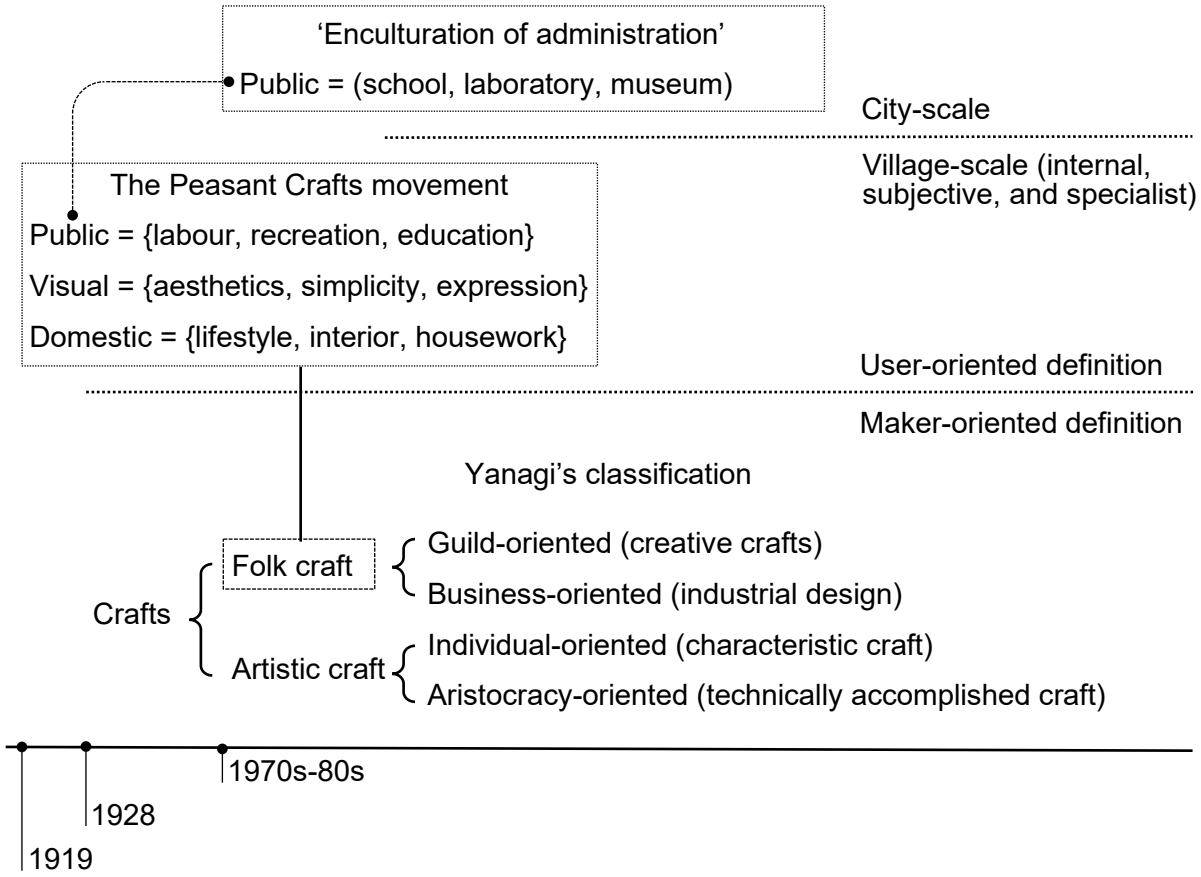

Figure 2. Extension of Yanagi's classification with the Peasant Crafts movement and 'enculturation of administration'.

7.2 The Peasant Crafts movement as design thinking

We can see a portrayal of the figurative behaviour of craft in the diagram above. The features of the Peasant Crafts movement are in the middle of the maker-oriented and user-oriented definitions; the peasants were both makers and users.

The diagram above might also indicate the birth of 'design thinking' in local communities. As Nigel Cross points out, 'A central feature of design activity, then, is its reliance on generating fairly quickly a satisfactory solution, rather than on any prolonged analysis of the problem' (Cross, 1982). Peasant Crafts was a solution for peasants to make public and domestic spaces creative or innovative through visual arts. We can interpret the diagram above as a formula to explain modern definitions of post-industrial craft.

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Embracing Change While Retaining the Existing: Sustainable Behaviour Design Insights from Astronaut Food Consumption Transitions

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Design has long been regarded as an effective tool to create and foster individual and societal changes. When design meets the opportunity to transform people's behaviour and habits, only focusing on the change aspect might be insufficient, the retention aspect also can have a crucial role to play in guiding people's sustainable lifestyles. This paper aims to fill this knowledge gap by shifting the lens from design for sustainable change to design for sustainable retention. In order to understand the role that the design of artefacts can play in retaining individuals' desired behaviour through context change transitions, first, we briefly summarize insights from the literature published in the design for sustainable behaviour (DfSB) field. Following that, astronauts' Earth-bound food consumption on the International Space Station (ISS) is taken as an explorative case study. By analysing the case study results through an activity analytical approach, we find that the effects of change do not always necessarily interfere with the effects of retention. Rather, they are compatible entities that can mutually affect the development of new behaviour and habits. We argue that design to facilitate change is not the only path that leads to users' sustainable behaviour, retaining people's existing ecologically desired behaviour can also open up windows of opportunity to embed sustainable design interventions in people's daily activities. This paper concludes with a call for further explorations of design opportunities and challenges for retaining people's existing ecologically desired behaviour.

Keywords: design for sustainable behaviour, behaviour change, behaviour retention, activity theory, activity-centred design

1 Introduction

Nowadays, individuals face both opportunities and challenges of change more than ever. These changes include individual life event transitions, such as residential relocation, new employment, having a baby (Schäfer, Jaeger-Erben, & Bamberg, 2012; Verplanken & Wood, 2006; Verplanken, Walker, Davis, & Jurasek, 2008), while they can also be triggered by longer and larger socio-economic events, such as impacts of climate change, implementations of new policies, and applications of new technologies (Thompson et al., 2011). From a design perspective, it is undeniable that all these changes can lead to

behaviour and habit disruptions which have direct impacts on the existing ways of how people use particular artefacts to carry out their daily doings (Verplanken & Wood, 2006).

In this transition process, some of people's existing doings might be changed while some might be retained as the result of the interaction with the available artefacts in the new contextual environment (Wood, Tam, & Witt, 2005). The interplay between the effects of change and retention may lead to the formation of new behaviour and habits, which in turn can influence the specific use of the particular artefact and thus reshape the design of the artefact (Kaptelinin & Nardi, 2012). When design meets the windows of opportunity for purposefully transforming people's behaviour and habits, change has been regarded as a fashionable goal that people in business, policy, and academia strive to achieve (Lockton, 2017). As a consequence, products and services are often designed to make desired changes to happen. However, in this trend of embracing behaviour change, we seem to have neglected the crucial role that a retention perspective -- to maintain people's desired ecological behaviour and incorporate them into the new behaviour patterns, can play in guiding people's sustainable behaviour transitions.

Looking at sustainable behaviour design challenges from a retention perspective, problems which need to be addressed by design can be interpreted differently. For example, facing the problem of the growing demands for personal automobiles, apart from investigating how to develop design interventions to reduce people' over overreliance on private automobiles, what we also need to consider is how to retain people's existing green transportation lifestyles when they can afford to purchase an automobile. Facing the household food waste problem, in addition to studying how to change households' food waste behaviour, what we also need to consider is how to retain people's existing environmental awareness and ecologically desired food consumption doings through design. If we shift the lens and view design not only as an agent for change but also as an agent for retaining people's existing ecologically desired behaviour, what new design opportunities and insights can be informed to facilitate people's sustainable behaviour?

We take this inquiry in the present study and explore the role that the design of artefacts (referring to products and services in this paper) can play in retaining individuals' desired behaviour through context change transitions. Astronauts' Earth-bound food consumption on the International Space Station (ISS) is applied as an explorative case study. The specific question that we aim to understand in this case study is how did the design of tools (artefacts) on ISS enable or restrict subjects (astronauts on expedition tasks) to retain the Earth-bound food consumption behaviour.

This paper makes two contributions to the field of design for sustainable behaviour (DfSB). First, it reviews the behaviour transition mechanisms with a focus on retention perspective, and argues that design to facilitate change is not the only path that leads to sustainable behaviour, retaining people's existing ecologically desired behaviour can also open up new opportunities to embed sustainable design interventions in people's daily activities. Second, with a focus on behaviour retention perspective, it proposes a set of practical design implications as the entry points for design practitioners and researchers to better cope with changes and disruptions that take place in people's daily life contexts.

2 Behaviour retention in design for sustainable behaviour (DfSB) studies

Before diving into the exploration of design for sustainable retention topic, we need to first take a step back and ask the question: Why should design practitioners and researchers working with sustainable behaviour design issues, start to consider design for retention while design for change has already become a famous term?

First of all, a successful behavioural transformation entails not only changing the undesired doings but also retaining the ecologically desired ones (de Koning et al., 2015, 2016). To avoid confusions, it is worth mentioning that the concept of retention discussed in this paper does not mean to either completely stick to old ways of doings or prevent changes from happening. Rather, it means to maintain the desired behaviour and incorporate them into the new behaviour patterns when people go through disruptions that take place in daily life contexts.

Initial insights from the previous study indicated that, compared with design for sustainable change, the topic of design for behaviour retention remains relatively untouched (Chu & Wever, 2017). In order to understand to what extent the retention aspect has been studied in design research, we conducted a non-exhaustive literature review in the present study. We began by simply identifying the number of publications within the general behaviour and design field on Scopus. The preliminary search result shows that the number of behaviour change-related publications (68 articles) is significantly higher than the behaviour retention-related publications (8 articles) (see Table 1). We then narrowed down the review scope down to the conference and journal articles published within DfSB research field in all years. In total, 57 articles were included in our review.

The result further indicates that the topic addressing how to retain people's existing ecologically desired behaviour was barely covered in DfSB studies. Among the 57 DfSB articles, only a few mentioned the sustainable design from a behaviour retention aspect. For example, in a sustainable household fridge and freezer design study, Tang & Bhaman (2012) observed that participants tend to check the contents in the fridge and then decide what food items need to be purchased, which is regarded as a desirable environmental behaviour for reducing household food waste. In order to better maintain this fridge content checking behaviour, they redesigned the layout and drawers of the fridge so that it provides a clear display of the contents inside, thus retaining people's existing behaviour at the same time reduce the unnecessary food and energy waste triggered by the use of fridge. In addition to that, in a hair care sustainable product design study conducted by Hielscher, Fisher & Cooper (2008), they identified sustainable design opportunities and insights by drawing on an in-depth review of people's past hair care practices.

Table 1 The distribution of literature search results in the change-related and retention-related category.

Search scope and terms	
Change-related	**Retention-related**
a). "Design for behaviour(al) change" b). "Sustainable behaviour(al) change" + "Design"	a). "Design for behaviour(al) retention" b). "Design to retain" c). "Retain/maintain behaviour" + "Design" d). "Behaviour(al) retention/maintenance" + "Design"
After screening	
68 articles	**8 articles**

3 Activity analytical lens

Either design for change or design with particular consideration for behaviour retention requires design researchers to develop an in-depth understanding of individuals' daily doings. Activity theory (AT) takes activity as the unit of analysis and provides a descriptive nature on understanding why and how people carried out a specific activity in a specific context to achieve a specific goal (Kaptelinin & Nardi, 2006). As illustrated in Figure 1, activity is interpreted as purposeful need-based interaction between the subject (actor) and the object (world) (Leont'ev, 1974, 1978). Six key theoretical concepts have been developed to better frame and interpret human activity system: 1). Motivations, goals, and outcome of the target activity under study; 2). Social and physical aspects of the context; 3). Mediating tools used to perform the actions and detail operations; 4). Contradictions and tensions within the target activity system; 5). Internalization and externalization; 6). History and development of the activity system (Kaptelinin, Nardi & Macaulay, 1999).

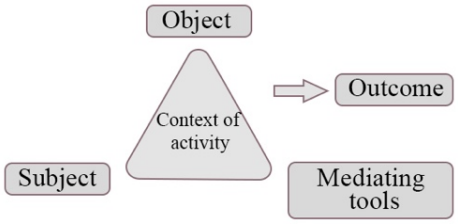

Figure 1. The activity theory model proposed by Vygotsky (1978). An activity system is viewed as a single triangle which comprises the interaction between subjects, objects, and mediating tools within a specific context to achieve a specific outcome.

Among the theoretical concepts mentioned above, two pillars make AT particularly helpful in individual behaviour related transformative design studies. First, taking an ecological perspective, it puts human activity systems in spatial (the concept of socio-cultural context) and temporal (the concept of history and development) dimensions. In other words, it views people's behaviour from a holistic and long-term perspective rather than simplified tasks and static interaction. As illustrated in Figure 2, the socio-cultural context enables design researchers to zoom in or zoom out to investigate how an activity is carried out in macro socio-cultural level, specific action level, and detail operation level. Furthermore, the temporal lens allows design researchers to analyse the disruptions and tensions within the dynamic development and transition process of the target activity system (Gay & Hembrook, 2004). Second, AT has a special emphasis on artefacts as mediators of change, it argues that a typical way to induce purposeful change in people's activity system is through changing the mediating artefacts that people use (Kaptelinin, Nardi, & Macaulay, 1999; Kuutti, 2011; Bødker & Klokmose, 2011). This concept is, to a large extent, in accordance with the goal of design for sustainable behaviour research, which focuses on improving the design of artefacts (commonly referred as products and services in DfSB literature) with a specific aim to guide users' behaviour in a more sustainable direction (Wever, Van Kuijk & Boks, 2008; Wever, 2012).

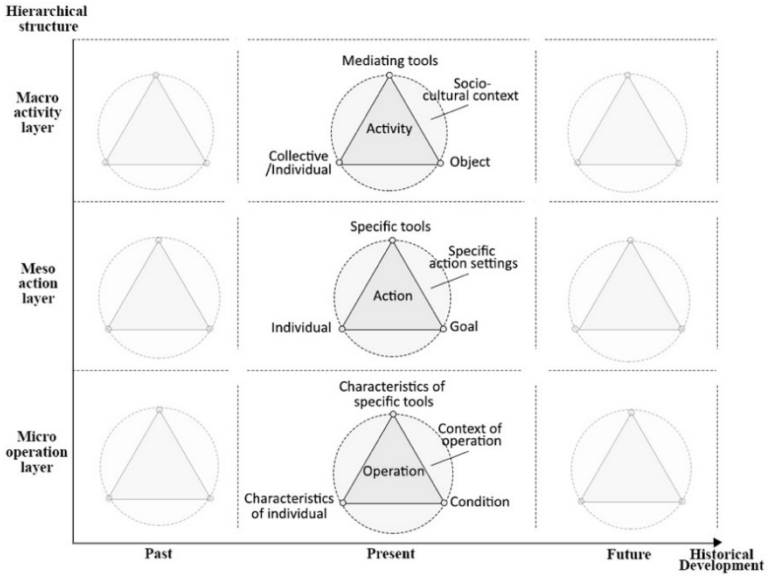

Figure 2. The activity theory analytical model adapted from Gay & Hembrook (2004).

Previously, we have applied the activity theoretical lens in analysing the food consumption activities that exchange students have transformed during their exchange studies. The results indicated that an AT-based analytical approach can systematically map and analyse not only the outcomes of individuals' behaviour transitions, but also the development process of how and why the transitions take place (Chu, Steenstra, Wever, & Glad, 2018). Based on the reflections indicated above, in the present study, we adopted AT as the analytical lens to reframe the sustainable behaviour change and retention phenomenon.

4 Astronaut food consumption case study setup

In order to understand the role that artefacts can play in retaining people's desired doings with support from real-life empirical data, we took astronauts' food consumption behavioural issues on the ISS as an explorative case study. This case study set-up was adopted by us based on two considerations: First, astronauts who on-boarded the ISS went through both physical and social changes from the Earth to a confined spacecraft environment. It is a highly representative real case scenario in which the subjects under study have undergone a significant contextual transition. This transition process thus can provide an appropriate setting for us to develop an in-depth view of why, what, and how particular behaviour can be retained through the interaction with artefacts, thus inform behavioural design implications.

Second, regarding the data availability and quality, astronauts who on-boarded the ISS have documented their daily activities such as work and experiment, food consumption, exercise, entertainment, and communication, along with their subjective experiences and psychological feelings in detail. The qualitative data provided us with a well-established background to extract the insights regarding the effects of design on behaviour transition. The data are available on NASA life sciences database archive, NASA technical report server, and crews and exhibitions page for public access. This also allows researchers with similar interests to analyse the data from their own research perspectives. As the present study focuses on food consumption behaviour, relevant descriptions regarding how astronauts carry out their food consumption activities (including meal preparation, eating, and food disposal stage), what tools they use in these activities, and the subjective experiences behind these activities, were included in the data collection and review process.

Both primary sources (expedition journals, photos, and video clips), and secondary sources (psychological and behaviour focused technical reports) were used as the empirical materials in the present study.

Through adopting the AT analytical lens, the empirical data was synthesized and analysed in an abductive approach. First, following the inductive coding method used by Stuster (2010, 2016) in astronauts behaviour studies, the descriptions of crew members' food consumption activities were extracted into segments in Excel sheets. Next, the descriptions were sorted into different categories with different themes. Identified themes that emerged from the raw material were summarized and incorporated with the themes we identified from the secondary sources published by NASA. Following that, the AT analytical lens was applied to interpret the themes. The analytical process is comprised of three steps: First, we illustrated astronauts' food consumption activity system in three contextual layers: the macro-layer represents the motives of food consumption activity within the social and physical context of the ISS. The meso-layer represents the specific actions that the astronauts need to be performed in order to attain the specific goal within their food consumption activity system. And the micro-layer represents the detail routine operations. After that, we illustrated the development of astronauts' food consumption activity within each contextual layer (see Figure 2). In the last step, each identified theme was interpreted through using the six AT theoretical concepts mentioned in the preceding section. The detail documentation of the analytical process applied in a similar food consumption case study can be found in the Chu et al. (2018).

5 Results and findings of behaviour retention in astronauts' food consumption activity system

An overview of astronauts' food consumption activity analysed through the concepts from activity theory is presented in Table 2 below.

Table 2. An overview of astronauts' food consumption activity analysed through the concepts from activity theory.

Activities	Motivations, goals, outcome	Social and physical aspects of the context	Mediating tools	History and development	Contradictions and tensions	Internalization & externalization
Cooking in space	Assemble different food resources to make a personalized meal, so that the meal tastes differently than the standard menu.	a). Food based on a 16-day standard menu; b). Limited ingredients and cooking tools; c). Cooking influenced by the individuals' daily schedule and workload; d). Cooking in the microgravity environment.	a). A water dispenser which can inject the selected amount of hot or ambient water to food pouches. b). Two food warmers to heat up food pouches or food cans.	a). Astronauts rehydrated or directly ate food in early space expedition project. b). However, as expedition duration becomes longer, astronauts start to prepare food to attain the Earth-bound food consumption experience.	a). Lack of food resources and cooking tools; b). Problems of operating in a microgravity environment.	a). Improvise with the available tools; b). Experiment with available food resources; c). Share recipes and learn from other crew members.
Eating in space	a). To enjoy company and use the occasion to chat with other crew members; b). To celebrate important events;	Usually 15-20 minutes gathering for eating and chatting around in the dining area each day.	a). A fold-down square table attached to the wall; b). A laptop computer as a TV attached to the wall; c). Both a physical space for eating and a social space for group interaction.	A transformation from food consumption as an individual activity to a group social activity. Resulting in positive psychological effects on both individual and collective level.	a). Limited space and facilities; b). Difficult to coordinate due to individuals' working schedules.	Schedule lunch or dinner time ahead and try to avoid eating alone.

5.1 Retention of cooking activity from Earth to ISS

Making personalized meal, referred by the crew members as “space cooking”, is one of the activities that have been retained from Earth living environment to the ISS environment.

Social and physical aspects of the context: The design of the dining system is to make astronauts’ food consumption process as convenient and harmless as possible to the safety environment of the ISS. Therefore, cooking activities is not considered in the original design of the dining system on ISS (Stuster, 2010, 2016). Food derived to ISS is based on a 16-day standard pre-packed menu and special “care packages”, however, repeating the same food which have similar textures and tastes in a long-term expedition can sometimes create potential psychological problems such as lower the individual performance and well-beings (Bartone et al., 2017; Stuster, 2011). For example, one of the astronauts expressed: “*Even with a 16-day menu and personal preference food thrown in, the food can get monotonous*”. Facing this particular appetite problem, the crew members retained and adapted their cooking behaviour from Earth environment to make personalized dishes on the ISS.

Motivations and goals: According to the descriptions in astronauts’ journals, the motivation behind space cooking is to make meals taste differently and less boring than the standard menu. One of the crew members explicitly indicated that “*it makes a difference to spend a little extra time in preparing the meals to make them more enjoyable. Although there is only so much you can do with space food, a little effort goes a long way.*”

Tensions and contradictions: The lack of cooking resources, including cooking products and services, is one of the main challenges that the astronauts face. Facing this problem, two new activities thus emerged from adaptation to the design of the dining system in ISS: improvise with the available tools and experiment with the available food resources.

5.2 Use of tools

Tensions and contradictions: Cutting board, pans, and oven are commonly used as tools to chop, mix and heat up food in people’s daily cooking activities on the group, the crew members reported that they also retained the similar doings on the ISS. However, the process can sometimes be extremely difficult compared to cooking on the ground as there is no gravity support nor plates or bowl-like containers on the station.

Mediating tools: To overcome this particular contradiction, the crew members came up with interaction with tools to improvise their cooking actions. For example, duct tape is used as *“small cooking plates*” to adhere food from floating away. One astronaut described “*I cut the onion in half, putting one on the tape for temporary stowage*”. Similar to the household doings on the ground, bags on the ISS, including plastic bags and foil food pouches, are collected and properly stored for cooking and disposing food. For example, one astronaut stated “*I grab the promising ones [plastic bags] and put them in my stash so I have them handy for the next cooking day.*” Some astronauts use those bags as disposable cutting boards, so that food ingredients can be cut inside the bags to prevent things from floating away and spreading in the air — “*to cut things up I use a plastic bag, held down by the duct tape*” (see Figure 3 below). However, plastic bags have a thin layer, they can be easily sliced or damaged. Therefore, the crew members have to be especially careful when cutting foods inside the bags.

When food needs to be warmed, thermostabilized foil pouches are used as pots to collect, mix, and heat up food ingredients. One astronaut wrote: “*I can put the garlic and onion in here [the pouch] with olive oil and form the bag to the size needed to go in the Russian food*

warmer." Consumed food cans are also reused as bowls for heating ingredients in food warmers— "*recycle the cans of Russian meat we had already eaten and use them to put the beans in for heating.*" Foil pouches and food cans have to be carefully sealed to avoid the leakage of any contents, especially liquid. For example, one astronaut stated "*It [olive oil that was put in] got out of the aluminium pouch and all over the oven*." Apart from that, tortillas are often used as plates to eat ready-made food. The moisture content of the food ingredients allows it to cling to the tortilla, thus it is possible to build several layers of different ingredients and mix the ingredients on the tortilla. Unlike on the ground, where we can perform our operations without conscious awareness of how to use tools step by step, the microgravity environment requires the subject to continuously put their conscious efforts in the process. One astronaut stated "*it is a testament to how much we enjoy tortillas that we routinely go through this whole careful process*".

Figure 3. Pictures of the astronauts' cooking. The picture on the left: the astronaut uses a tortilla as a plate to put more ingredients on and mix them together by a spoon; The picture on the right, the astronaut uses duct tape and plastic bags as tools for mixing ingredients. Source: https://www.nasa.gov/centers/johnson/astronauts/journals_astronauts.html

5.3 Cooking experimentation

Motivations and goals: To the crew members, the effect of cooking does not just limited to making personalized dishes that taste differently from the standard menu, it can also remind astronauts' the particular feelings of being on the ground at home - -*"It was a great combination [referring to one dish] - reminded me of home eating frosting with my sister", "It really tasted like a cheesecake, right out of the oven with a berry topping", and "Getting in the mood for Easter… I have been experimenting with our dehydrated eggs."*

Development: As the result of cooking experiments, astronauts get more adapted to the cooking activities. For example, some crew members stated: *"I have definitely been on a learning curve. With each successive experiment I am getting less and less messy", "Tried a new recipe this week. I am getting better at combining the food."* In order to enable other crew members to reproduce the dishes that have been created before, the crew members also share their cooking knowledge and techniques with each other. For example: *"Fyodor showed us how to put the garlic paste right on the tomato with the cheese. Then we did the same thing with the horseradish", "Another trick I learned from Peggy was how to prepare roasted garlic in the Russian food warmer."*

6 Discussions and implications for sustainable behaviour design

So far, we have interpreted the empirical data through an activity analytical lens, following that, we have reported in detail regarding how the astronauts retained their Earth-bound food consumption activity on the ISS. This section briefly discusses what design implications in

terms of retaining people's doings through context change disruptions can be informed through this explorative case study.

6.1 Scenarios and mechanisms of retention

Retaining the subject-goal mediation: The results of this specific case study indicated that the usage of a particular artefact and its corresponding user behaviour are, to a large extent, depending on its subjects' pre-existing motivations and goals in the context of the activity. In the case study, the astronauts usually seek, test, and adjust available tools and then incorporate these tools into their space cooking activity system to meet their particular goals. These goals were often adopted from their pre-existing Earth-bound food consumption experiences. For example, in order to make a more personalized meal, astronauts used the foil food pouches (which are brought to the ISS with the original purposes to better preserve food and make the food eating process simple and convenient), in combination with duct tapes and plastic bags as containers to hold, cut, mix and heat up food ingredients. These tools were used to replace the role that a cutting board plays on the ground. Similarly, in order to bake food, the astronauts also came up with the idea to use already consumed foil pouches and food cans to replace ovenware used in Earth-bound cooking environment. As illustrated as the scenario1 in Figure 4 below, this retention in subject-goal mediation process resulted in the adaptation of different usages of the available artefacts, which is consistent with Engstrom's argument, that the way how users interact with mediating tools depends on the specific goal that users aim to attain, there is always more possible uses than the original design intention (Engstrom, 1990). In other words, this scenario can be described as: *Although the existing ways and corresponding artefacts that subject can use in a specific activity system have been transformed, the specific goal that subjects aim to attain can still remain unchanged. As a result, the available artefacts are adapted to retain the goal.*

Retaining the subject-tool mediation: As activity can shape the particular use of mediating artefacts, the design of these artefacts can also reshape the way in which the activity is carried out (Gay & Hembrooke, 2004). For example, as mentioned in the result section, due to the constraints of the cooking tools and the microgravity environment on the ISS, the crew members had to adjust their cooking activity to simply combining and assembling different food ingredients. Although the space cooking activity was different from the Earth-bound cooking, the astronauts still retained the specific behaviour when interacting with some particular mediating tools, such as use tortilla as plates to mix and hold different food ingredients, use food warmers to heat up food, collect and re-use bags to temporarily store and wrap ingredients. This retention phenomenon which took place in subject-tool interaction process is illustrated as the scenario 2 in Figure 4, which can be described as: *Although the subjects have adapted and developed new goals within a specific activity system, the existing interaction with the corresponding mediating artefacts still remain unchanged.*

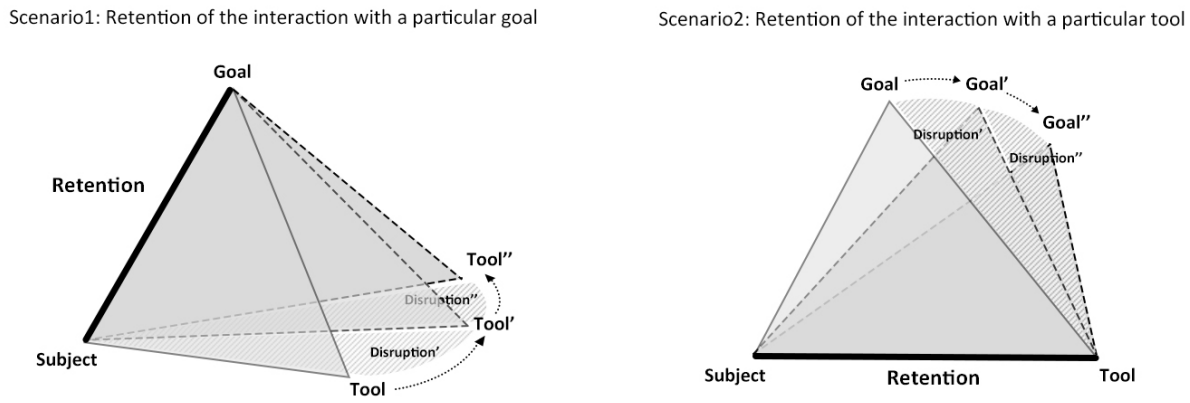

Figure 4. Two scenarios where retention can take place in user activity systems. Note that this model is constructed based on the human activity model proposed by Vygotsky (1978) illustrated in Figure1.

Both scenarios can simultaneously take place in individuals' daily activities. Taking household dishwashing as an instance, the fundamental goal of the activity can be simply described as to clean the used dishes. For households without access to dishwashers, hand wash is the only way to carry out the activity and attain the goal. However, the installation of dishwashers in such households can create a context change disruption, which might trigger a behaviour transition from hand wash to using the automatic dishwasher (as illustrated in Scenario1). At the same time, it can also transform the original goal into various new goals such as quick clean, eco-wash, and high-temperature disinfection (as illustrated in Scenario2).

6.2 Implications for sustainable behaviour design

Given the understandings of different retention scenarios and their potential influences on people's existing activity systems, the questions then come to how this insight can be applied to better frame people's behaviour transition process, and what new sustainable behaviour design opportunities can be informed by putting on the retention lens?

Gaining a holistic view of the interplay between change and retention: Today's products and services often function in complex networks which are not static but under dynamic development. The usage of a particular design is not only determined by its users, but also influenced by (a) other products and other people involved in the networks, and (b) the context in which it operates (Wever et al., 2008). As indicated by Gay & Hembrooke (2004), if contextual disruptions become materialized in the networks, it can quickly become the driven force for the evolution and development of people's activity system. The results from the case study indicated that, for individuals who are undergoing the context changes, in order to overcome and minimise the impacts brought by the disruptions, part of the existing links in the target activity system can be broken while new links will be established and further tested (e.g., as presented in Section 5.3, learn to cook a personalized meal in microgravity environment). Simultaneously, part of the existing links can also be retained and even solidified (e.g., as presented in Section 5.2, collect plastic and foil bags and re-use them as cooking tools).

This revealed an interesting phenomenon in people's behavior transition process, the effects of change do not always necessarily interfere with or counteract the effects of retention. Rather, as presented in this astronaut food consumption case study, they can coexist with

each other within the development of people's activity system. To be more specific, as illustrated in Figure 4, under the circumstance that the original tool (marked as Tool in Scenario1) that subject interact with has been changed to a set of new tools (marked as Tool' & Tool''), the original goals of the activity can still be retained as the same. Similar to that, if the original goals (marked as Goal in Scenario 2) that the subject aim to attain has been changed to a series of new goals (marked as Goal' & Goal'' in Scenario 2), the specific interaction with the particular mediating tools can still be fixed in the whole activity system. These insights, while preliminary, suggest that it is the cooperation between the effects of change and retention that constitutes the development of new behaviour patterns and habits.

Change is not the only path to sustainable behaviour: As behaviour change and retention are compatible entities which can mutually affect the formation of new behaviour and habits, design to facilitate change is not the only way to achieve sustainable behaviour transitions. Purely focusing on fostering changes may let design practitioners and researchers neglect the questions such as what ecologically desired behaviour have been performed by users in their past or existing activities, what factors can help to materialize the particular desired behavior, and what design insights can we learned from those past and existing activities. To answer the above questions, a behaviour retention perspective can offer a complementary view to examine the mainstream behaviour change design concepts, which might open up new windows of opportunity to embed sustainable behaviour design in people's existing daily doings (see Figure 5).

Taking grocery shopping activity as an example, the traditional grocery market allows customers to make tailored selections of food items and pay accordingly, which provided customers with flexible spaces to avoid potential food waste issues and at the same time save money. However, this pre-existing environmental way of grocery shopping has been influenced by the modernized supermarket service design and the excessive reliance and unnecessary usage of packaging. With the aim to help consumers re-gain the customization and at the same time minimize the use of packaging in grocery shopping, Komazec & Wilhelmsson (2017) developed a mobile wagon packaging-free food purchase system, which enables consumers to purchase selected amounts of food items from gravity silos with automatic built-in scales and barcode printers. This design concept is not only focusing on identifying consumers' current needs, but also taking the retention aspect into consideration by drawing on people's pre-existing ways of shopping.

Practical design questions to consider: As pointed out by Papanek & Fuller (1972), one of the prerequisites for tackling wicked real-world sustainability problems is to understand the underlying effects and impacts of design in a more systematic way. In terms of design for sustainable behaviour, an activity development perspective may offer a holistic perspective to help design practitioners and researchers to identify which target activity should be the focus of change and which should be retained and developed further. However, developing an in-depth view of both the change and retention aspects in each specific design setting at the same time may require enormous time and efforts from designers. One suggestion is to start from the intersection between change and retention in early-stage design ideation process, and then shift the focus to the details of change or retention aspect. For example, if a new product design concept is being developed with the goal to facilitate users' sustainable behaviour, since disruptions and behaviour transitions may perhaps take place in users' existing activity system as one of the potential outcomes of this design, design

practitioners and researchers might need to consider: How can this particular design fit into users' existing activity systems? What elements of the activity need to be completely preserved as the foundation for users to carry out the target activity? What should be slightly refined and modified by this design? What should be dramatically altered? What new subject-product-goal links might be altered or established? And what aspects should be taken into consideration for the next transition stage that may happen in users' activity system? The process of seeking answers to the above questions might also facilitate design practitioners and researchers to prepare themselves for an even broader question: how can design itself better cope and cooperate with changes and disruptions that take place in people's daily life?

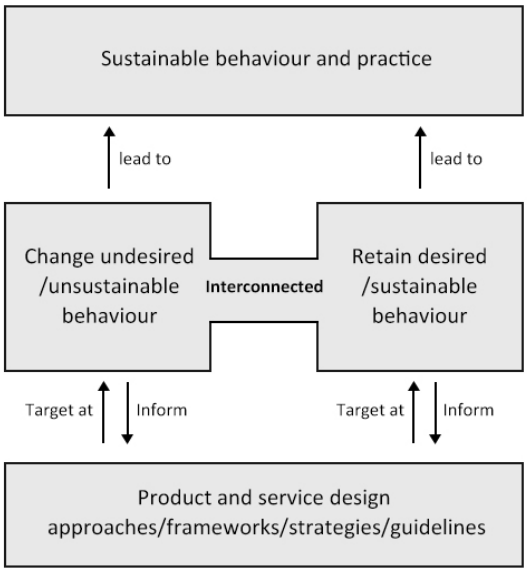

Figure 5. A proposal to incorporate the goal of retaining the existing ecologically desired behaviour with the goal of changing people's undesired behaviour into the consideration of sustainable product and service design.

7 Conclusion, limitations and future research

This study set out to explore what if we view design as not only an agent for creating behaviour change but also an agent for retaining people's existing ecologically desired behaviour? As one of the initial steps to approach this inquiry, this paper specifically focuses on exploring the role that design of artefacts can play in retaining individuals' desired behaviour through context change transitions.

Through applying an activity theoretical lens, we found that the effects of change and the effects of retention should not be viewed as two sides of a paper, one side tends to cover the existence of the other. Rather, they are compatible entities that can mutually affect the development of new behaviour and habits. Based on this understanding, we argue that design to facilitate change is not the only path that leads to users' sustainable behaviour, design to retain people's existing ecologically desired behaviour can also open up windows of opportunity to embed sustainable behaviour in people's daily activities. In order to achieve this goal, efforts need to be made to help design practitioners and researchers to incorporate both change and retention aspects into product and service design process. The overarching design question which needs to addressed in the next stage is how design can support

users in attaining the newly emerged goals while retaining their existing ecologically desired behaviour in the development of their activity system.

The lack of primary empirical data, such as one-to-one interviews with astronauts, is one of the limitations behind the set-up of the astronauts' food consumption case analysis. However, the descriptive qualitative data collected in this study can already enable us to peek into what has happened in the astronauts' food consumption transition process. And then conduct an in-depth analysis regarding what activities have been changed and what have been retained. Furthermore, the findings are subject to one particular case study. In the future, more case studies need to be conducted to provide complementary views.

Behaviour retention aspect also shares some common characteristics with the design strategies proposed for behaviour change. As indicated in Wever et al. (2008), there are two most common approaches to create behaviour change through design: functionality matching and behaviour adaption. Functionality matching means to induce the preferred behaviour by designing products and services features to match users' preferences, while behaviour adaption means to the design features which may force changes to happen. Can these two approaches be directly applied to retain people's desired behaviour or should those principles and strategies be adjusted? Discussing these questions goes beyond the scope of this paper. However, for future studies, one promising way is to review relevant sustainable behaviour design strategies and approaches with a particular focus on the retention aspect, and then interview experts regarding what design strategies have already covered behaviour retention aspect, and what design strategies should be further developed to incorporate retention aspect into the system.

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Exploring the Effect of Product Development Time Span on Product Paradigms Through Phones

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This article examines the effects of product development process durations on paradigms through desk phones and smartphones. Product paradigms are launched with radical innovations, being developed further with incremental innovations for optimization. It is argued that the technology and meaning of products change incrementally in the market pull innovations. It is stated that human-centered design studies bring the paradigms to the optimal point. However, the speed of the product development, when determined by the incremental innovations in technology, can have a negative impact on human-centered design studies. In this conceptual framework study, the evolutions of desk phones and smartphones are compared; it is observed that smartphones may not have benefited from human-centered design studies yet. It was concluded that rapid technological developments could shorten the product development processes and human-centered design studies could remain diminished, avoiding the paradigm to reach the optimum level.

Keywords innovation; incremental innovation; product development; human-centered design

1 Introduction

With the improvements through both design and technology, products that perform a certain function may face paradigm shifts in the course of time. Evolution and change of paradigms may be explored through recent models in innovation to understand the effect of the product development process durations on product forms.

Verganti (2009) investigates innovation within two axes; technology and meaning. Technology axis refers to the technical changes in products, being in-line with the prior studies on innovation (Cooper and Press, 1995; Trott, 1998). One major contribution of Verganti's (2009) study is, he appreciates design as an element of innovation; innovations in product meanings are the outcome of the design. Each product development process can be assessed as an innovation, and radical or incremental innovations may appear in the meaning axis, technology axis, or both.

The evolution of a product concept starts with radical innovation and reaches to a certain optimum through incremental innovations (Norman and Verganti, 2014a). Incremental innovations occur through human-centered design; it is also claimed that radical innovations do not emerge as a result of human-centered design (Norman and Verganti, 2014a; Verganti, 2009). Therefore human-centered designs are needed to take a product to its optimum.

In this study, the effect of product development time span on product paradigms is explored through causal narratives of smartphones to argue if shorter product development times lead to underdevelopment in product paradigms. The focus is put on industrial design and the meaning level, and technological innovations and meaning driven innovations are evaluated separately. The aim of this study is to form a conceptual framework to discuss if products that are mostly developed as a result of incremental technological improvement may lack human-centered design efforts to reach an optimum product form, which is more in line with users' natural actions and expectations.

This study aims to discuss the topic on a conceptual level to illustrate the issue and build a ground for upcoming theories on the subject (McGregor, 2017). Conceptual frameworks are valued as they pointing out potential topics that can be explored in depth through an evaluation of existing theories and studies, without presenting new data (Yadav, 2010). The topic is explained further through desk phones and smartphones. They exemplify the effect of rapid incremental technology-push; they are suitable to act as causal narratives, which help to clarify and explain further the topic through one or two cases (McGregor, 2017).

2 Product innovation types and their effects on product paradigms

As mentioned before, recent studies on innovation acknowledge design as an innovation generator. The emergence of a new product paradigm occurs with radical innovations. Here, radical innovations of technology and meaning are evaluated separately, to be followed by incremental innovations of both. As the innovation of meanings refers to minor changes in the form of the product (Verganti, 2009) and incremental technology innovations not necessarily address a change in the product form, incremental innovation of technology is considered as a driving force for new form development.

An earlier example for identification of technology and design-related axes can be seen in the work of Cagan and Vogel (2002); they define 'style' and 'technology' to differentiate product types. They also define ergonomics as another aspect that only appears in breakthrough products that will demonstrate high value in SET (style, ergonomics, technology) factors. Cagan and Vogel's (2002) work can be differentiated as they put more focus on usability and user expectations, while Norman and Verganti (2014a) do not assess user orientation for breakthrough changes. Since the innovations that are not solely user-centered are also in the scope of this study, Verganti's model is considered.

There are four main innovation types that are defined by Verganti (2009). A technology-push innovation constitutes a major change in technology, without a major change in the meaning and use of a product; the transition from CRT TV's to LCD TV's is mentioned as a typical example (Norman and Verganti, 2014a). A technology epiphany is the radical change of both technology and meaning, such as the change in video games by the introduction of MEMS accelerators to trigger exercising concept by Nintendo Wii (Dell'Era et. al., 2010). Lately named as meaning-driven innovation by Norman and Verganti (2014a), the radical change in meaning with minor or no change in technology can be observed in Alessi's Family Follows Fiction product family (Verganti, 2009). Finally, market-pull innovation addresses minor changes in meaning and technology with the human-centered design being the major source of innovation (Norman and Verganti (2014a).

2.1 Effects of technology-driven radical innovations on product paradigms

As mentioned earlier, technology-driven radical innovations not necessarily have a major effect on product meanings. Technology change in TV's did not immediately result with a meaning change (Norman and Verganti, 2014a); even though new technology enabled a more compact solution with wider screens that can be hanged on walls, TV's were not repurposed for a while. However, physical changes through a technology push innovation may cause alterations in product paradigm, leading to a technology epiphany with the radical change of the product meaning.

In prior studies, the paradigm change is discussed on a communicational and semantic level; introduction of microchips to products that serve for the functions of musical instruments, notebooks,

telephones and such, led to disappearing of communicational cues on these products, leading to a paradigm loss (Bayrakçı, 2004). Unlike designing an electro guitar, designing a synthesizer became a task of covering a black box and creating an interface between the user and the product, without being led with visual cues of mechanical details (Bayrakçı, 2004). The paradigm loss here described as a change in both technology and meaning.

A paradigm shift may also appear with a technology change appearing in products that are considered as black boxes. Nintendo Wii employed MEMS accelerators to change the way the video games are played; formerly players sat through play, but Wii guided them to a new meaning through active involvement in movements required by the game (Verganti, 2011). Although the design problem was still at the black box level, the designs of the control units completely changed as the result of the new meaning.

Radical innovations in material technologies may also lead to new product meanings. Furniture companies are known to have cooperation with material suppliers in an effort to create radically new product meanings (Dell'Era and Verganti, 2007). Also, material suppliers seek for new product meanings themselves in order to trigger alternative product forms in the industry that employ new materials (Verganti and Öberg, 2013).

2.2 Effects of design-driven radical innovations on product paradigms

A meaning driven innovation changes the meaning of the product in a radical way, without a major change in product technology. A typical example is Alessi's Family Follows Fiction series. Even though forms of dancing women, ducks and parrots were introduced to kitchenware (Verganti, 2008), the main user-product interaction and communication followed the prior paradigms. The furniture industry is also widely considered in meaning driven innovation studies; the introduction of innovative forms and styles are considered as radical innovations through design (Dell'Era and Verganti, 2009); however paradigms of furniture and their communications with users rarely changed.

Technology epiphanies combine radical changes in technology and meaning. Sometimes the application of new technology may trigger the innovation. The introduction of mobile communication technology led to the development of mobile phones that did not operate as former mechanical phones, introducing a new paradigm. However, a radical change in meaning can also trigger the employment of technologies that are known before. For instance, Nintendo and the electronics industry, in general, were aware of accelerators; their inclusions to video game consoles were brought about by the change of the product meaning (Verganti, 2009). Likely, smartphones with touchscreens were developed as early as 1992 and marketed in 2000, the first smartphone to be mainly controlled by a touchscreen was Apple's iPhone being introduced in 2007 to change the mobile phone market (Zapata et. al., 2015). The widespread integration of touchscreens to mobile phones may be due to the meaning change, as iPhone redefined mobile phones as customizable products that can even be turned into broadcasting devices with the help of applications.

It can be said that plain meaning driven innovations may not necessarily end up with paradigm shifts. Even though Norman and Verganti (2014b) stress that meaning driven innovations occur through a merger of two different product meanings, this may not affect the product paradigm; an example would be the combination of meanings of toys and kitchenware in Family Follows Fiction, which resulted with products that had familiar mechanisms and communication cues.

2.3 Effects of incremental innovations through human centered design

The human-centered design is claimed to be the driving force behind market pull innovation. Norman and Verganti (2014a) state that incremental innovations bring every radical innovation to its most developed level. Regarding the product paradigms, it can be said that human-centered design helps a paradigm to reach its optimum level.

Norman and Verganti (2014a) evaluate this phenomenon with a hill climbing metaphor. A radical innovation represents a starting point for a product concept; however, it is generally not the most

refined and debugged version. Writers compare the development of a product concept to a hill climbing process; the initial product form is like a lower point on the hill and incremental innovations always search for a higher point on the hill, leading the product to the top. The top of the hill is where the product reaches its optimum level; any further search for another level on the same hill will lessen the quality of the product, but another hill with a higher peak may be searched through another radical innovation (Norman and Verganti, 2014a).

While prior literature defines incremental innovations basically as small improvements within a product concept (Trott, 1998; Cooper and Press, 1995), Norman and Verganti (2014a) highlight the importance of the subject with emphasizing human-centered design, which helps the product to reach its absolute best version.

It can be said that through human-centered design, the communication between user and product becomes more apparent in products with better fitting usability solutions for product paradigm. The referred phenomenon is studied further through the example of desk phones in the following parts of this study to discuss the subject.

3 Phones: comparing the basic functions in mechanical and electronic phones

In this part, desk phones and smartphones are evaluated through their basic functions to investigate how well their paradigms adapt to users' natural behaviors and expectations.

It is expected for a product paradigm to reach a point where the product and the user act at an optimum communication level, where they are adapted to each other. This optimum communication may not always be dictated by users; Norman (2005) points out that, users have the capacity to adapt to new products. Therefore, he claims that designers should consider the adaptation capacity of a human, and not strictly follow their declared expectations (Norman, 2005). It may be claimed that both users' and products' adaptations should be considered through the evolution of a product, as they both have a potential for evolution to fit each other. Therefore, both users' and products' adaptation capabilities are in the context of this study.

3.1 Evaluation of desk phones

The initial concepts for the desk phones appeared as early as 1876 (Bell, 1876). The device evidently evolved over time to provide a better response to users' needs and basic habits.

Figure 1. Alexander Graham Bell, Experimental Telephone 1876, Museums Victoria.

Bell's initial sketches for telephone illustrated devices with very large cones for mouthpiece and receivers, with communication seemingly being one-sided (Mercer, 2006). Bell developed his model

further to be granted a patent for the product; as it can be expected, in his patent appeal he described the technical infrastructure and affordances such as two-sided communication (Crompton, 2009).

The initial model for the telephone is presented in Figure 1. As it is shown, the device exposes much of its technical details without providing clear data on how to make a call or where to talk. After the initiation of the telephone, the design of the device began to transform; some typical designs emerged, such as Butterstamp in 1878 (which combined receiver and transmitter into one unit), 3-Box in 1882 and Candlestick in 1897 (Mercer, 2006). Figure 2 shows the basic principle for transmitters and receivers for 3-Box and Candlestick phones; users hold the receiver to their ears while they have to place their heads close to the main body of the phone in order to use the transmitter. Figure 2 shows a later example of such a principle; the numbers are placed on the device for making a call.

Figure 2. Wall Telephone - Automatic Residence Set, circa 1920 Museums Victoria.

The well-known desk phone paradigm appeared around 1928; a desk set that united the receiver and transmitter with a handle (Mercer, 2006). The common proportions for this paradigm became popular with the design "300" in 1937 (Mercer, 2006). Recent studies credit the model to George Renwick Lum rather than Henry Dreyfuss, who is acknowledged as a consultant, and his style is stated as being visible in the final product (Flinchum and Meyer, 2017). Dreyfuss is acknowledged for his method of study, which is considered a very early example of ergonomics science and usability, as he measured many people and work with users to find out what they actually did with phones (Mercer, 2006). Even though his actual role in refining the paradigm is discussed as there were similar designs produced by other companies like Ericsson, there is plenty of evidence showing that his ergonomics studies along with other designers played an important role for optimizing the product (Flinchum and Meyer, 2017).

Telephone with buttons has been developed since the 1960s (Flinchum and Meyer, 2017); however, the main ergonomic principles stay pretty much the same when making and ending a call is considered.

A phone call with a classic desk phone paradigm starts with raising the handle. Raising the handle has a direct relation with making a call, as users should bring the receiver close to their mouths and transmitter to their ears in order to make a call. The handle between transmitter and receiver provides a semantic clue about where and how to hold the part. The call is ended with bringing the handle to its resting position on the device. Unlike initial examples of the telephone, the mainstream paradigm is more in line with users' expectations and actions. As the aim of users who bring the headset to their head would be to start a call, the activation of the telephone by raise of the headset is in line with users' purpose. Again, leaving the headset back on the device would only be done at the end of a call; therefore deactivation of the phone also follows the same logic. Here, the opposite of action results in reverse outcome; raising the headset is activation and setting down is deactivation. This kind of logical relation between two actions is named as "natural and consistent mapping"; and keeping the actions in line with users' natural behaviors (like placing the headset to head to make a call) is referred as "mimic normal use" (Ruiz, et. al., 2011).

It can be inferred that the desk phone designs started with initial examples that emphasize mechanical details on the product form. Later on, telephones were designed which communicate better with users through more natural and logical actions for operation. Studies on the history of desk phones suggest that human-centered design activities and ergonomics studies that were applied may have helped the phone paradigm to reach an optimal level.

3.2 Evaluation of smartphones

As mentioned before, the touchscreen smartphone concept goes back to the beginning of the '90s, and the IBM Simon is widely acknowledged as the first smartphone that has been marketed, which is developed in 1992 and launched in 1993 (Buisson and Silberzahn, 2010; Gupta and Prinzinger, 2013). Today's smartphone paradigm is based on Apple's iPhone, which was launched in 1997, as it's claimed to be imitated by its competitors (Buisson and Silberzahn, 2010). However, it's claimed that a dominant design hasn't emerged immediately, regarding the software and infrastructure (Cecere et. al, 2015).

Modern smartphone design is dominated by a screen, where the graphics for applications that are operated in the phone also appear. Since the screen is the basic interaction area, the communication of the smartphone with the user through a screen is often discussed as a design problem. Most of the time, visual references from tangible correspondences of applications are included in the visual design, leading to criticisms about skeuomorphism (Page, 2014). In order to make interaction less screen oriented and more physical on smartphones, some studies tested touch-less gesture controls (Lu et. al., 2013), which are widely used in industries such as household, security, fitness, education and so (Gavrilova et. al., 2018, Khan, 2018).

The studies for the usability of smartphones are important on many levels. As expected, it's claimed that using the controls that are suggested by users is important (Rauch, 2011), as users' usability perception affects their attitude towards smartphones (Shin, 2012). It may be difficult for designers to apply standard usability principles, as there are many operating platforms for smart devices that should be considered (Rauch, 2011; De Luca and Lindqvist, 2015). The software interface of a smartphone is considered as the main medium for constructing meaning, being the core element for usability (Folkmann, 2012). The studies about the usability of basic functions focus on software commands and search for their physical equivalents. Studies show that to build a more inclusive design, especially regarding the visually impaired people, physical references are needed as users find it hard to spot the command areas on the screen (Mi et. al., 2014).

Since this paper focuses on the basic functions of a phone, answering and ending a phone call in a smartphone is evaluated.

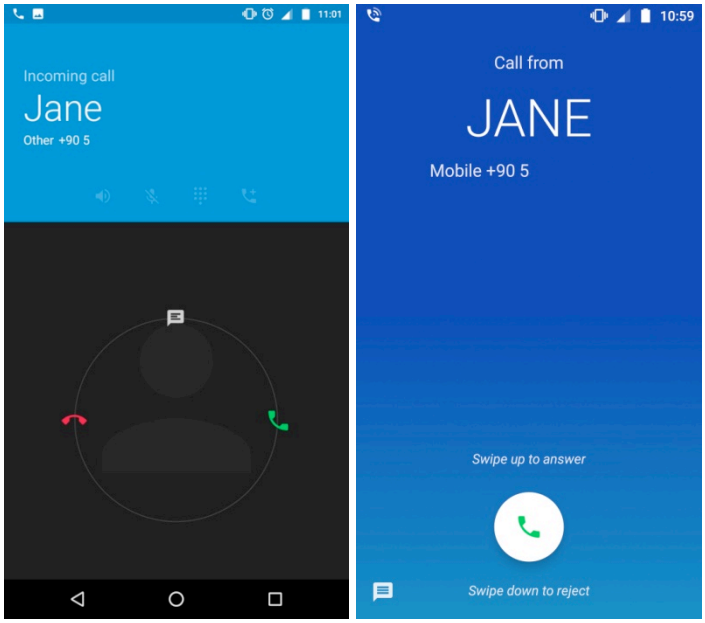

Figure 3. Answering a call in the last two versions of the Android operating system (Screenshots by author).

In Figure 3, two different answering tasks can be seen. The one on the left is from the previous version of Android, while the one on the right is the recent version. The finger move to answer a call has changed to sliding the finger to the up from sliding the finger to the right. Both of these movements are versions of the original sliding move from the IOS system, and both of them are commands that belong to the software paradigm; they have no relation to actual moves of a user who answers a phone.

To make smartphones more usable for visually impaired, studies were done to understand the more easy-to-remember and natural moves for basic phone tasks. Two of these studies derive similar solutions from users to answer a phone; users find it natural to bring the smartphone to the ear for answering a call (Dim and Ren, 2014).

There are also gesture controls that are assigned to smartphones by operating systems. Two examples are shown in Figure 4 and Figure 5.

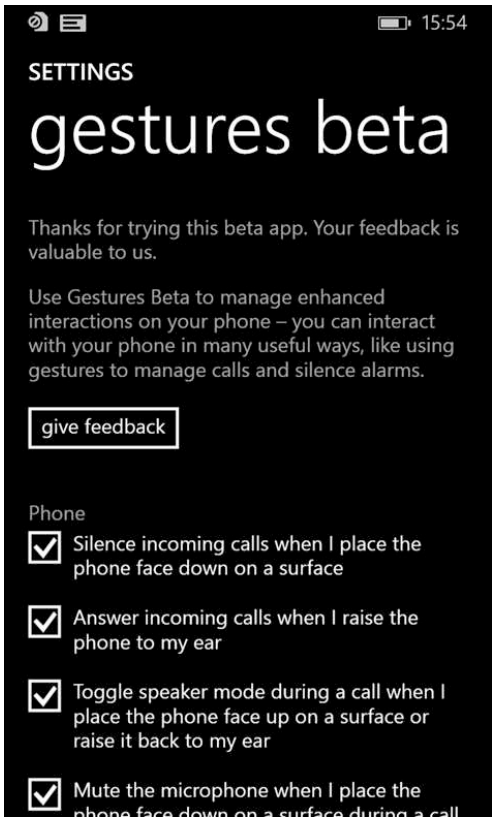

Figure 4. Screenshot of Gestures Beta (Microsoft Mobile).

Figure 4 shows options in Gestures Beta, an additional application by Microsoft Mobile for Nokia Lumia smartphones, while Figure 5 shows Moto Actions that provide gesture controls for Motorola smartphones. As can be seen from the figures, the same gesture of putting the phone face down can serve for two different actions; eliminating the environment voices when listening to the caller through the speaker in Lumia phones, and eliminating sound notifications during standby mode in Motorola phones. Picking up a ringing phone silences the ringtone in Motorola smartphones, which can be considered as “mimic normal use” as a ringtone is not necessary when someone is paying attention to a ringing phone. Raising a ringing phone to ear results with answering the phone in Gestures Beta, and this move is in line with the user expectations that are detected in the studies (Ruiz et. al., 2011; Dim and Ren, 2014). Putting a phone face up to a surface during a call puts it in the speaker mode in Gestures Beta while raising it back to ear mutes the speaker; both of these actions can also be evaluated as mimicking normal use.

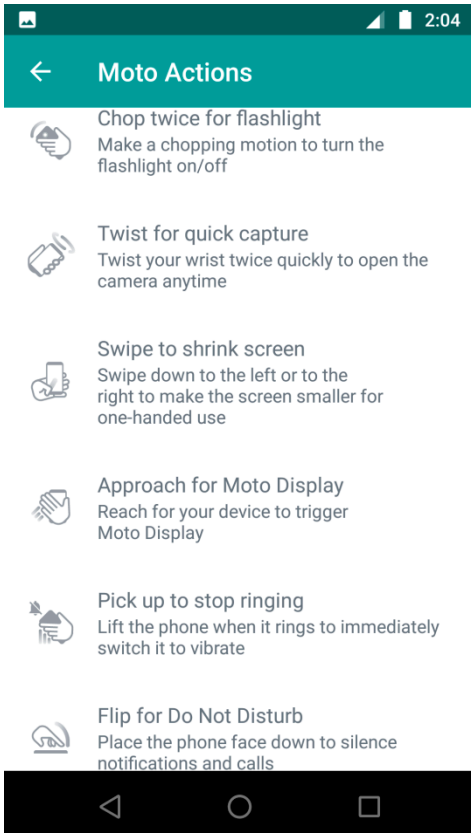

Figure 5. Screenshot of Moto Actions (Screenshots by author).

Ending a call with gestures can be more complicated in smartphones, as removing the phone from the ear is necessary for completing dialing tasks within some phone calls, such as speaking with customer services. This is due to the fact that the dialing area is not separated from the receiver and transmitter as it is in the desk phones. Some users suggest taking the phone from the ear and facing it down to end a call, claiming that it mimics a desk phone; this type of analogies are labelled as “real-world metaphors” (Ruiz et. al., 2011). In Dim and Rem (2014) study, visually impaired users suggested putting the phone on any surface after removing it from the ear. Even though this preference may interfere with a hands-free phone call, the suggested gesture is in line with “mimic normal use” behavior.

To sum up, it can be said that current smartphones operate pretty much similar to the prior solutions. The smartphone paradigm reached its dominant physical appearance through Apple iPhone; with the dominant use of touchscreen technology, there was a radical innovation that can be named as a technology epiphany. However, the upcoming incremental innovations did not bring many different solutions to usability. Regarding the basic phone functions, answering and ending a phone call is mainly done through software interfaces in smartphones and this tendency is in-line with the original smartphone solution that dictates today's paradigm. However, some more natural gesture alternatives, which are in line with user expectations, have been provided for answering a call through additional applications. One of these provided solutions is in line with the "mimic normal use" gesture type. Ending a phone call with a gesture is more complicated regarding the call tasks that require dialing numbers, but users suggest "real-world metaphor" gestures to overcome the issue.

4 Comparing the basic functions in mechanical and electronic phones to evaluate the effect of product development durations

The evolution of desk phones and smartphones are slightly different when triggers for innovation are considered.

The desk phones' mechanical and electrical design has not changed much after the initiation of first examples for the paradigm around the 1930's; however, infrastructure and production improvements had some effect on the product (Mercer, 2006). On the other hand, smartphones are affected by the improvements in electronic equipment, such as disc drives, which are considered as "fruit flies" of the business world as their lifecycle is quite short (Christiensen, 1997). This results with shorter life cycles for smartphones as mentioned by studies that focus on sustainability (Ylä-Mella et. al. 2015; Cox et. al., 2013). Companies that compete in the consumer electronics industry by developing incremental innovations declare that usability researches are not frequently conducted because of the short life cycles (Eroğlu, 2019). Also, it is reported that very basic usability problems happen to occur in consumer electronics products, as declared by their users (Kim and Christiaans, 2016). Short life cycles and lack of usability in consumer electronics may address a lack of human-centered design studies in smartphones.

Since desk phones took advantage of usability and ergonomics studies when finalizing the product paradigm, their adaption to users' needs and natural behaviors when making a call can be linked to the slower change in the technology. A slower change in technology enabled a more evident emphasis in product design within market pull innovation, resulting in a better application of human-centered design. On the other hand, smartphones as we know today has not faced a breakthrough change in technology that affected the paradigm; however, they evolved through many incremental changes that were pushed by technology upgrade, leading to shorter life cycles for the products (Arthur, 2002, Entner, 2011).

Even though later models of desk phones and smartphones can be both considered as market pull innovations, the effect of human-centered design differs in the two paradigms. Norman and Verganti (2014a) place human-centered design at the hearth of market pull innovation, but it may be discussed that technology-driven incremental innovations sometimes may hamper human-centered design efforts. At this point, it may be helpful to discuss if constant incremental developments in the technologies have a technology push innovation effect, even though they are not radical innovations. However, the faster abandonment of the phones for up-to-date products suggests that users also demand technology updates such as longer battery life, better screen, more internal memory and such (Entner, 2011; Cox et. al., 2013).

It may be investigated if frequent technology driven incremental innovations hamper usability analysis to avoid the product paradigm to reach its optimum level. As mentioned before, a product paradigm first appears through radical innovations, which needs more developments in order to eliminate problems in the original design (Norman and Verganti, 2014a). However, the lack of time in product development may avoid the foundation of better solutions for a design problem. The cognitive effect behind this phenomenon can be better understood through the literature on design fixation.

Studies on design fixation suggest that designers seem to repeat a solution for a design problem, if they are exposed to it prior to the problem-solving process (Jansson and Smith, 1991. It is also stated that expertise in an area may increase fixation tendency (Purcell and Gero, 1996; Björklund, 2013) and industrial designers tend to get fixated on product forms (Cheng et. al., 2014). Within domain analogies are formerly defined solutions to a design problem; they create a possibility of problem fixation through semantic analogies (Moreno et. al., 2014). There are studies which suggest designers are affected by existent solutions that are presented; many of them have a tendency to fixate on visual examples rather than verbal explanations, even though the visual examples are inaccurate (LeFevre and Dixon, 1986; Smith et. al., 1993; Chrysikou and Weisberg, 2005; Christiaans and Van Andel, 1993). In order to diminish the fixation effect, several strategies are suggested. Some studies suggest “forgetting” the problem by staying away for a while, which may decrease the fixation occurrence (Kohn and Smith, 2009; Smith et. al, 2011). It is claimed that context change, therefore staying away from factors that cause fixation is an effective method to avoid fixation (Smith and Linsey, 2011). Moreno et. al. (2015) also state that having breaks or dealing with other tasks that are

irrelevant to the original problem may lead to disconnection and separation to avoid getting fixated on exemplary solutions.

When desk phones and smartphones are compared regarding the improvements in usability, it can be claimed that shorter life cycles may keep the product paradigm away from reaching its optimal level. As the product development process become shorter, designers may have fewer opportunities to conduct human-centered design studies and they may get more fixated to original solutions that had formed in software design. Also, the shorter product development times may hamper their chance to stay away from the design problem in order to create better or more original solutions, keeping themselves from getting fixated to prior solutions.

5 Discussions

Literature suggests that new product concepts come out as a result of radical innovations, and they reach their optimal level through human-centered design studies that occur in incremental innovation processes. However, frequent incremental technological improvements can shorten the product life cycle, resulting in diminished human-centered design practices. Although incremental improvements in technology can be considered market-pull or even human centered in a way, human centered design activities that concentrate on product meaning can have a significant effect on optimization of the product paradigm.

When the cases of desk phones and smartphones are compared, it can be seen that desk phones favored from ergonomics studies and usability researches. After the mainstream paradigm appeared in 1928, ergonomics studies were conducted within the next 10 years to optimize the paradigm. The final form of the paradigm fits users' natural movements when they make a phone call. On the other hand, the current smartphone paradigm faced many incremental improvements on the technological level, however, it lacked usability improvements. Smartphones did not face major form changes unlike the desk phone did within the first 10 years after initiation in 1876, nor did they reach their optimal ergonomics and usability level as the desk phones did through 1928-1937. The first 10 years of smartphones may be considered as a fine-tuning period; however, this would mean that incremental technological improvements should slow down at some level.

The incremental innovations in smartphone technology may or may not slow down in the near future. Independently from upcoming developments, it can be said that technology-driven incremental innovations' effect on market pull innovations should be discussed regarding the design input. The current state of smartphone paradigm suggests that shorter product life cycle and product development periods may hamper human-centered design studies. This may keep the product paradigm from reaching its optimal level, as the human-product interaction and communication can still be needed to refine. Therefore, in the market pull innovations, where both technology and meaning evolve incrementally, attention may be given to the speed of technological improvements to understanding the progress of usability of the product and evolution of the paradigm to its optimal level. In Verganti’s (2009) model, incremental innovation in both meaning and technology results with the human-centered design. However, in the case of smartphones, the actual designs today do not fit with the preferences declared by users in several studies (Dim and Ren, 2014; Ruiz et al., 2011), and the uses of the devices are not clear. Therefore, it may be worth investigating if incremental innovations that are mainly driven by technology can be linked strictly with the human-centered design.

This study is limited to the evaluation of product development duration's effect on product paradigm through the literature on innovation regarding the optimization of product contexts, and the main aim of this paper is to initiate a discussion on the subject. The issue can be explored further with more examples to understand the effect of technological improvements' speed on product life cycles and specifically human-centered design, to understand the dynamics behind the optimization of a product paradigm.

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Figure References

Figure 1. “Experimental Telephone, Alexander Graham Bell, 1876”, Museums Victoria. https://collections.museumvictoria.com.au/items/411376, Date of reach: 16.09.2018.
Figure 2. “Wall Telephone - Automatic Residence Set, circa 1920”, Museums Victoria. https://collections.museumvictoria.com.au/articles/16334, Date of reach: 16.09.2018.
Figure 3. Author’s screenshot
Figure 4. “Gestures Beta”, Microsoft Mobile. https://www.microsoft.com/en-us/p/gestures-beta/9wzdncrcx3n9#, Date of reach: 19.09.2018.
Figure 5. Author’s screenshot

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Impact Methods for Making a Change

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The aim of this paper is to describe theory and practice of methods for making a change. The methods in focus are called impact methods and they are used for defining effect goals that focus the outcomes and impacts of a transformation design project. They are used by user experience (UX) and service designers in Sweden and are potentially useful also in other design fields. In an interview study with seven practitioners and three originators of the methods, we ask what conceptions they have of their methods. They thought of them as methods for co-design, for designing the right thing, and for making strategy actionable. Four conceptions of impact methods were about: (A) having clear goals; (B) designing for user needs; (C) linking user benefits and features to business benefits, and (D) an approach to problem-solving. It is concluded that the impact methods have potential to be used to connect design and business, but they may also be drivers in transformation design.

Keywords: impact methods; transformation design; transition design; service design; user experience

1 Introduction

Design can be defined as devising action to transform existing situations into preferred ones (Simon, 1996), but how do you decide what are preferred situations and for whom are those situations preferred? It becomes imperative to understand what the change should be after the designed product or service is in use or operation. Once we reach such an understanding, we can then devise actions for transformation or transition (Sangiorgi, 2011; Scupelli, 2015), that are necessary to achieve the change. The conception of design as transformation means that design becomes central for strategic and tactical management (Holmlid, 2008; 2009; 2012). There are two extremes in approaching transformation and change, either as something manageable (Simon, 1996), or as something organic and emergent (Orlikowski & Hofman, 1997). In both of these there is need to balance ways of working that aim for coordination and collaboration (Johansson, et al 2011).

Transformation or transition design must be critical of the status quo of the societal situation, and it must be change-oriented and value-based (Tonkinwise, 2015). It builds on taking a stance on what is important, and for whom or for what something is valuable and good. What valuable and good design is, is however not a

straightforward question. It can involve design for a variety of different sorts of good: utilitarian, instrumental, technical, medical, hedonic or the good of humans (Arvola & Holmlid, 2016; Ylirisku & Arvola, 2018).

This will entail identifying objectives and criteria beyond the scope of technology or single products (Foglieni & Holmlid, 2017; Holmlid, 2014). The design effort involves reaching effects that make a change, which turns it into a form of change management, similar to how the design of information systems have been approached by Orlikowski and Hofman (1997) Setting design goals can also include articulating desirable qualities, values in use, and user experience (UX) goals, that reflect what users and stakeholders consider to be worthwhile (Arvola, 2010; Cockton, 2006; Kaasinen et al., 2015; Löwgren & Stolterman, 2004).

The purpose of this study is to describe methods used to create an understanding of change, by working with defining desired change in terms of effect goals that focus the impacts and outcomes of a transformation design project. In particular, the study will focus on a family of related methods we call impact methods, that are used by UX and service designers in Sweden. In the following section, a description of Effect Managing, Goal Managing, and Impact Mapping is given (see also Domingues et al. (2014)). Effect Managing and Goal Managing has gained considerable adoption in Sweden, and some in the other Nordic countries. Impact mapping is gaining traction among agile practitioners around the world.

The research question is, what different ways of conceiving “impact methods” practicing UX and service designers have. The question is approached in an interview study with designers about the methods they use. Consequences for transformation design are discussed in the final section of the paper.

It should be noted that this paper does not present a comprehensive in-depth study. Instead, interviews elaborate on experiences from design practice and facilitate the understanding of the methods.

1.1 Effect Managing

Effect Managing is an IT project management method based on the deceptively simple ideas that: (a) IT projects are initiated to generate a return; (b) enabled by specific measurable outcomes; which (c) are created as the system is being used (Ottersten et al., 2002). Furthermore, Effect Managing recognizes that usability and user experience are critical for a system to achieve its intended business goals. The approach aims to establish causal and logical links between users’ goal achievement and project success. Essentially, in order for the project client or sponsor to accomplish the purpose (“why?”), measured using the defined metrics (key performance indicators, KPI), the prioritized target groups (user groups, “who?”) need to be able to fulfil their goals (“what?”) using the features of the product (“how?”). These links and dependencies are visualized using an what is called an effect map as in figure 1, which can be regarded a variant of an objectives tree

(Cross, 2008; Jones, 1992) that visualize an effect taxonomy (Hertzum & Simonsen, 2011a; 2011b) of how to deliver value for business or society (Ward & Daniel, 2006).

The method entails creating a visualization of links between business goals, stakeholders, and requirements in a tree-like structure. The tree shows a hierarchy of a project purpose, broken down into multiple KPIs, that are realized through an application (or other solution) that enables specific stakeholders to accomplish their goals by using a set of features or functions, expressed concretely as requirements. The effect goals describe the difference made, for the business and for the users, when this particular IT system is completely in use (Domingues & Berntsson, n.d.).

The effect map is typically based on qualitative interviews with management stakeholders and decision makers (Domingues & Berntsson, n.d.). The interviews aim to answer the following question: What has become better in the business when the service is completely in use? It is necessary for the researcher to read up on the business to be able to narrow in on the concrete effects that the IT system is supposed to create. Annual reports, business stories, strategy statements, and similar documents are invaluable to learn what is valued in the business or government agency. Competitive analyses and evaluations of existing services and systems are also valuable sources of information. Workshops can be used to inspire and reflect on the results.

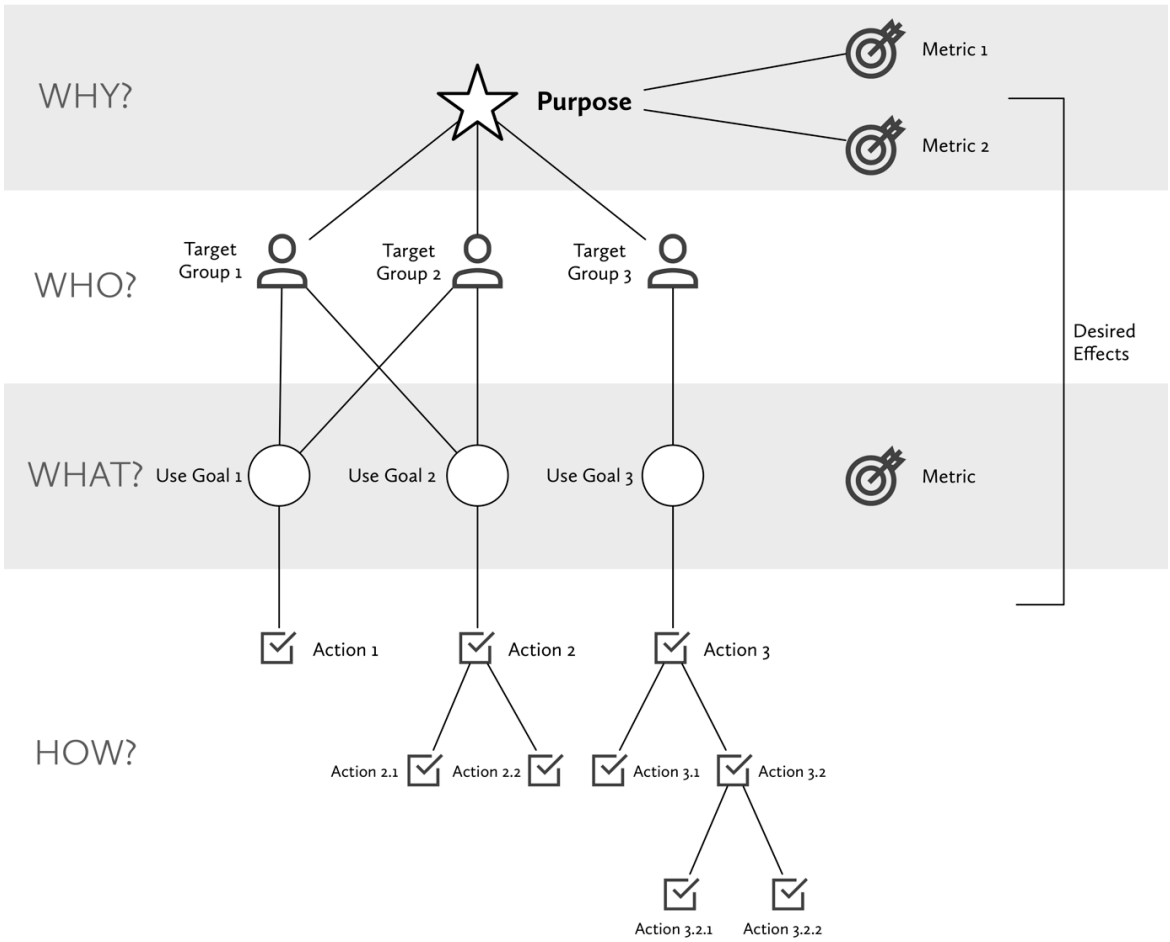

Figure 1. The structure of an effect map—adapted from Ottersten et al. (2002).

Effect goals are then formed in four, not necessarily consecutive, activities (Domingues & Berntsson, n.d.):

1. Decide what kinds of effects the service or system is expected to give (e.g. efficiency, improved brand loyalty, knowledge, interest, simplicity, speed, employee's work satisfaction).
2. Decide what the changes should be for each type of effect when this particular service or system is in use, and how those changes might be measured. Different metrics may measure different aspects of the changes, and only some of them can be directly related to the particular system or service. For example, there are different ways of measuring work satisfaction, such as self-rating and employee turnover, but can that be related to the design of an intranet? Evaluating if the intranet has made employee's work more rewarding, meaningful, or easier may be better measurements of work satisfaction in such a case.
3. Decide the method used to measure the effect goals.
4. Decide when to measure and what the expected measurements are. For example, it could be that the expected effect is that 9 out of 10 users should state that using the intranet is meaningful to them.

Activity 1 and 2 are the most important early on to be able to set the level of ambition and scope of the IT project, while activity 3 and 4 can wait to a later stage of the project (Domingues & Berntsson, n.d.). However, there is a risk of disagreement among stakeholders if you wait too long to have the discussion on metrics and measurement. Deciding the level of ambition and scope may require one or two workshops with decision makers and clients. The effects identified as the purpose (i.e. the why-level in figure 1) facilitates the identification of relevant target groups for the project (i.e. the who-level), which directs the following user research and conceptual design work in which users' goals can be identified (i.e. the what-level). Task analysis, subsequent requirement specification, and detailed design work constitutes then the how-level of figure 1.

As the method of Effect Managing was adopted, as well as adapted, by others and variations to the method started to appear. Two of those variations are Goal Managing and Impact Mapping described below. These methods largely share the principles, visual structure, and hierarchy of Effect Managing, but they differ in emphasis and approach.

1.2 Goal Managing

Goal Managing is a method that aims to bridge the gap between the business perspective of the client and the technical engineering perspective of the IT supplier, by means of user-centered (UCD) methods (Markensten, 2005). The bridge between business and IT consists of the activities that constitute the business and the interaction with the IT that users engage in to perform the activities (figure 2). UCD provides thus a concrete link between business goals and particular design decisions.

The design should bridge between the wishes of the client, the needs of the users, and the business objectives and aims to satisfy both users and management. Traditional UCD techniques (e.g. user research, prototyping) are used early at the levels of activity and interaction to discover and identify requirements and to understand the present and future usage. This allows discovery of what functionality a product should have and why. It also facilitates detailing of the interaction and user interface.

Hammarström (2014) described the procedures at a course in Goal Managing:

1. Get an orientation and read up on the project, the company, and the case, and plan the work.
2. Interview stakeholders (decision makers and influencers, including managers and employees) at the procuring organization.
3. Define goals and metrics in a cross-functional workshop with stakeholders, for example, web strategists, decision makers, and lead developers. The aim is to answer the following question: Why are we doing this project and what effects are we hoping to see? The answer articulates a change that provides a clear business value which everyone present recognizes and agrees on. What to measure and how is also defined, and a hypothesis about who the end users are is made in the form of a persona hypothesis, which will facilitate recruitment of participants for user research.
4. Analyze target group based on user research (primarily semi-structured interviews) to understand the goals and needs of users. The results are compiled into personas, i.e. fictitious characters that represent groups of users (Cooper, 1999; Cooper et al., 2007).
5. Present personas and use goals in a workshop with the client.
6. Map and develop scenarios, similarly to Effect Managing, to visualize the connections between satisfying the needs of a specific target group (who?) and the accomplishment of the effect goals (why?), as well as scenarios that connect the target groups with situations of use (what?).
7. Prioritize items in the map, since not all target groups contribute equally to the effect goals, and not all scenarios have the same bearing on the effect goals.
8. Define actions in the form of features or requirements (how?) that will be built during implementations. Inspired by user stories, they can take the format: “For <effect goal>, as <target group>, with <need>, I can <feature>, within <scenario>”.

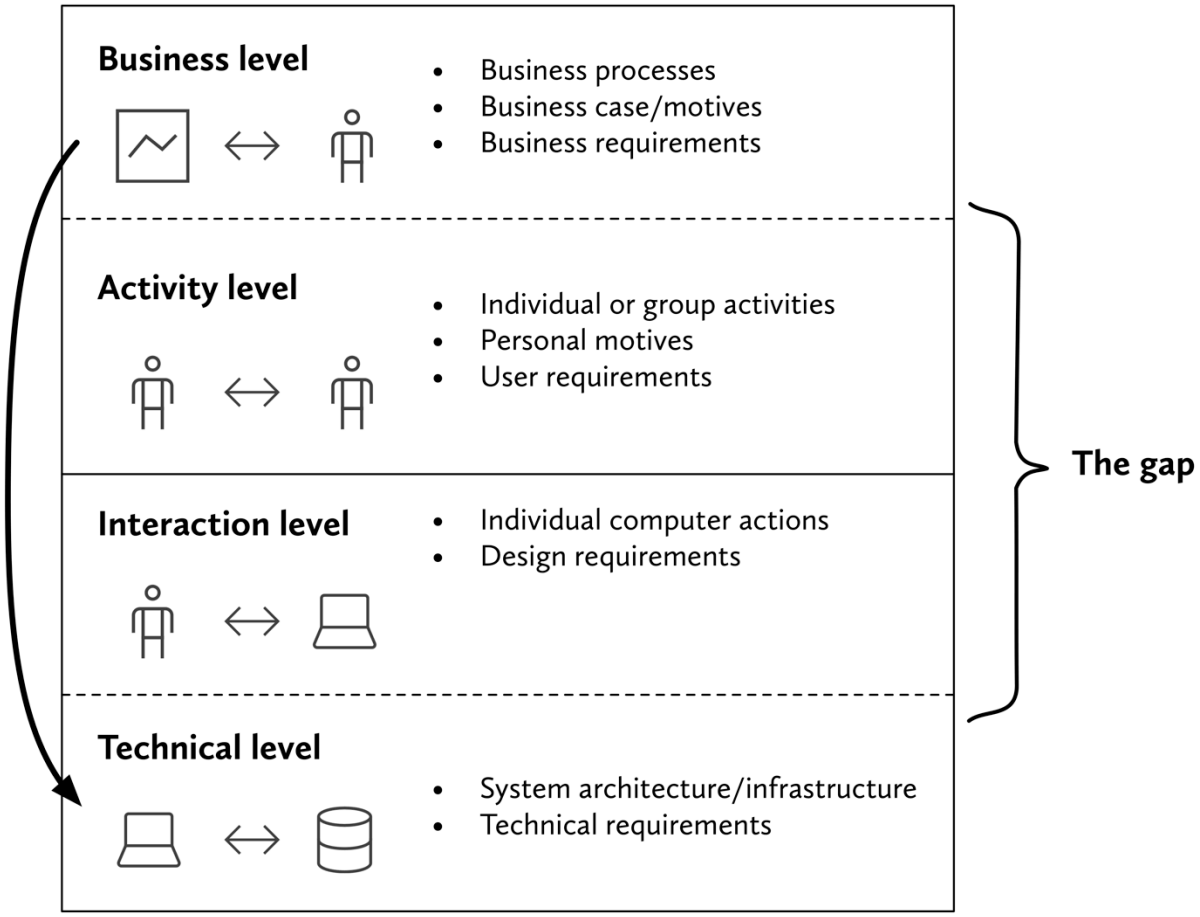

Figure 2. Levels of system requirements—adapted from Markensten (2005).

In a larger project, the map will grow considerably as actions are added. Navigating the structure may be difficult. Instead, the actions can be written in a spreadsheet, extended with use cases and linked to specific target groups along with estimates. This can serve as raw data for the project backlog. The spreadsheet can also be used to generate maps centred around target groups or goal effects.

1.3 Impact Mapping

Inspired by Effect Managing, Adzic (2012) developed his approach called Impact Mapping. Effect Managing and Goal Managing were born to address some of the problems with waterfall methods, by focusing on what goals users will try to accomplish using the product and how that contributes to business goals. Impact Mapping has a wider concept of stakeholders. An Impact Map can for instance list competitors as a stakeholder, their goals, and actions to counter the initiative.

Impact Mapping is rooted in agile project and product management in software start-ups where business viability is as important as usability (Adzic, 2012). It can draw on the expertise of many co-designers and visualize assumptions, user goals, and hypotheses about features that meet those goals. Figure 3 shows an impact map.

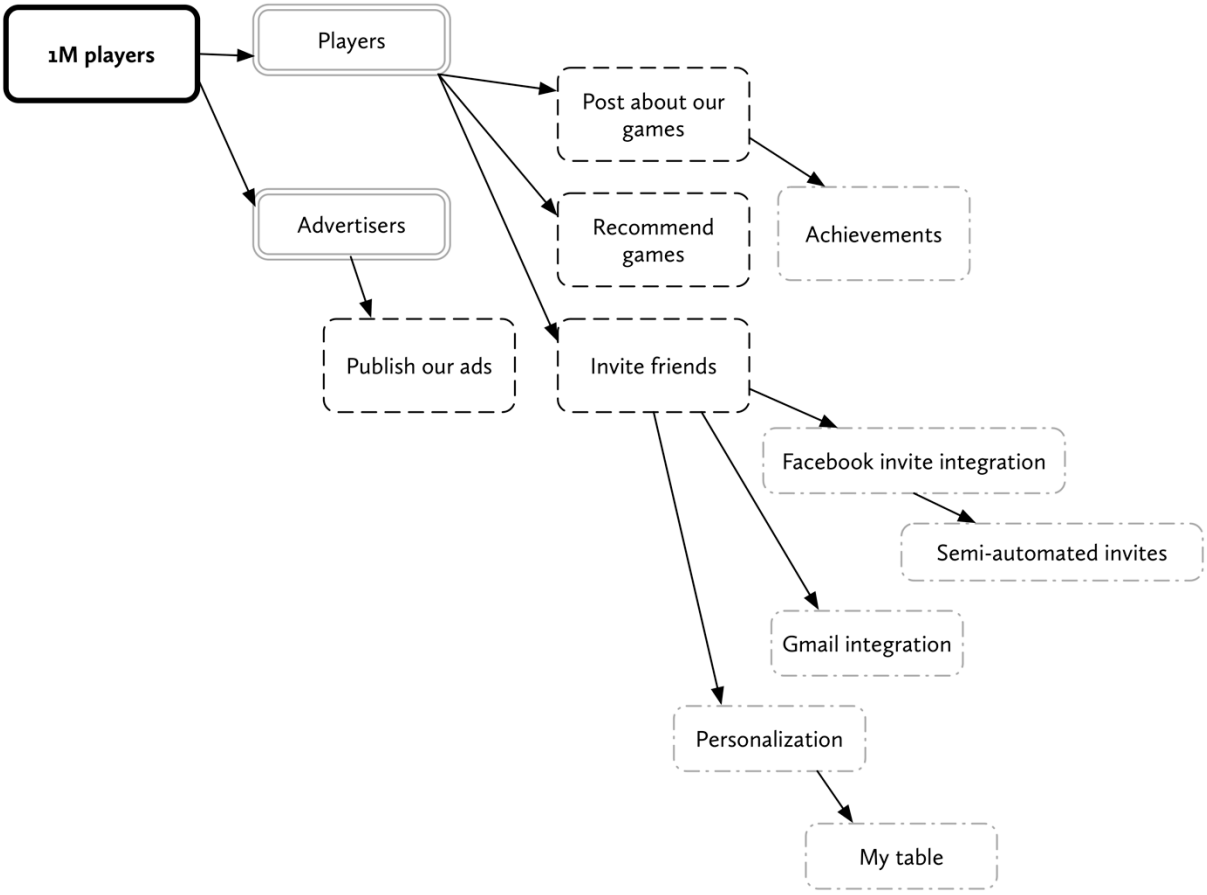

Figure 2. Impact map—adapted from Adzic (2012).

The mission statement (“1 Million players”) forms the root node (why?). On the second level are actors (“players and advertisers”) that can contribute to realizing the impact (who?). On the third level are the impacts (e.g. “invite friends”) that they can have (what?). Below that are deliverables for the software team to build that form features that they would use (how?). The process for Impact Mapping is based on two workshops. The goal of the first workshop is to produce a clear mission statement, in three steps:

1. Identify business objectives and not features. It is important to reach agreement on the scope and the number of goals per project. One goal per milestone is appropriate.
2. Define measurements for the goals which will steer the discussion towards priorities and viability. The discussion will include what will be measured (scale, e.g. number of monthly active players), how it will be measured (meter, e.g. using the game database), what the current situation is like (benchmark, e.g. 350,000 players), the minimum acceptable value or break-even (constraint, e.g. 800,000 players) and the desired value (target, 1,000,000 players). All numbers do not have to be in place at this point. It can be figured out in the time leading up to the second workshop. It is important to measure what is meaningful and has bearing on the intended goal rather than what is easy to measure.

3. Decide what the first milestone should be, for example: “Milestone 1: More players in 6 months, no negative impact on retention, 100% increase in IT costs permitted if needed.” The scale for “more players in 6 months” might, for example, be the number of monthly active players. The meter is the game database. The benchmark is 350,000 players. The constraint is 800,000 players. Finally, the target is 1,000,000 players. Scale, meter, benchmark, constraints, and target can also be defined for IT costs and player retention in this milestone example.

The goal of the second workshop is to map how to accomplish the mission statement and the milestones. This is achieved in four steps:

1. Draw a map skeleton by placing the first milestone at the centre of the map and connect it to a few high-level deliverables. Actors and their impacts are scrutinized by asking questions like: “Is it realistic that the feature will contribute to the impact?”; “is the impact valid for the actor?”; and “will the impact really contribute to achieving the goal?”.
2. Ideate divergently and find alternative ways to accomplishing the impacts.
3. Identify key priorities and converge by looking for constraints, show stoppers, low-hanging fruit that is easy to implement but yields a high return, and assumptions that need to be tested. Adzic (2012) suggests using Kano models (Jokela, 2004) to determine the desirability of features.
4. Discuss what will be built or done, i.e. the deliverables. The following questions can structure the discussion: What is the simplest way to support this activity? What else could we do? If we're unsure about the assumption, what is the simplest way to test it? Could we test it without software? Could we start earning with a partly manual process?

The map that is created is not a static document. It is intended to be re-visited during a project or product lifespan as results are measured. Deliverables that do not produce results hint at invalid assumptions. In the example given, it might be that players are not interested in inviting friends. If so, the “invite friends” impact might be invalid, or perhaps the deliverable is wrong. This way the map can be used to formulate and test experiments and determine if a given product strategy is working. Impact map practitioners that were interviewed stated that maps are often drawn on whiteboards or walls and revisited and updated continuously to reflect the current knowledge state in the product team.

2 Method

We have now described how impact methods are supposed to work in theory, but the research question for this interview study is what different ways of conceiving “impact methods” practicing UX and service designers have. Interviews were firstly made with three originators (2 male and 1 female) of the methods and the results of those interviews were used to get an overview of and introduction to the methods. Participants for further interviews were recruited based on references and

recommendations from contacts, personal network, and a survey posted in a LinkedIn group. Interviews were then made with seven UX and service design practitioners (4 male and 3 female) who used the impact methods in human-centred design work. The one who had least professional experience of the methods had worked with them for 3 years, three had used the methods for 5-6 years, and two participants had 10 years of experience of the methods. All had used the methods during the last six months. Three worked with internal projects and three with business-to-business projects. Five of them had experience from working with Effects Managing, three of them had experience from working with Goal Management, and only one of them had experience from working with Impact Mapping. Their age varied between 30 and 45.

The semi-structured interviews lasted 60–90 minutes. The protocol covered how they would describe the impact methods, their experiences of using them in particular projects, how they have adapted the methods, and relations to other methods. The interviews were recorded and transcribed verbatim at a level where pauses and non-verbal utterances were captured.

The first round of analysis employed phenomenography (Marton & Pong, 2005) and focused on the practitioners' conceptions of impact methods, i.e. the qualitatively different ways in which they understood the methods. The transcripts were subsequently also analysed using a conventional thematic analysis using holistic coding (Saldaña, 2013) to describe recurring underlying patterns defined by a central organizing concept regarding the application of the methods.

Participants were anonymized and data was encrypted for safe storage. It was ensured that participants understood that they could withdraw from the study without any further consequences for them. They were informed about the purpose of the study and that consent was obtained. In the cases where interviewees can be identified, a written consent has been obtained, and those participants have also been asked to review and confirm that the text is an accurate reflection of their views. The researchers had neither affiliation to the originators of the methods, nor any interests in the companies at which the participants work.

3 Results

Interview results are presented thematically, starting with general observations about the methods before going into details. A richer account with excerpts can be found elsewhere (Persson, 2017). Overall, four conceptions of what impact methods are about could be discerned:

- A: having clear goals
- B: designing for user needs
- C: linking user benefits and features to business benefits
- D: a way to think about problem-solving

3.1 Effects Managing

The structure of the effect map is an important part of Effect Managing. It has a well-defined formalism that allows it to be used for managing IT for specific outcomes and follow up effects over time. It is intended as a model for a set of ways to look at a problem and attempts to model the gains from a project. Effect Managing endorses defining a single purpose with a number of KPIs. According to practitioners in our study, this is frequently glossed over, to the detriment of the project, due to the difficulty of defining goals and metrics. Users are grouped according to their behaviour. In an intranet project, such behaviour groups could be titled “the seeker” and the “the informer.” These behaviour groups are not mutually exclusive and that a user may belong to more than one group. Such brevity serves to clarify the links between purpose, users, and user goals. The effect map can safeguard against adding features that cannot be traced back to user needs and organizational purposes.

3.2 Goal Managing

Goal Managing is not a strictly defined process, and the exact application of the method varies somewhat. However, the notion of a visual goal map is central. The application of Goal Managing in service design has given the method a different focus, compared to Effect Managing, which was originally conceived to address the challenges faced in IT projects. As a result, Goal Managing has incorporated high-level scenarios in the map to add the contextual dimensions needed for service design.

3.3 Impact Mapping

Only one of the participants had worked with Impact Mapping. Impact Mapping takes its departure in the realization that, for business success, product features cannot just be something that the team comes up with. It would be too expensive and too risky. You need to bring all stakeholders into a discussion about the product goals. Impact mapping is, therefore, a conversation and a planning technique to achieve particular business objectives rather than following plans dictated as a set of actions. The aim of Impact Mapping is to get people in a room around a whiteboard and helping them articulate their ideas on what to strive for.

3.4 Perceived Contributions of Impact Methods

The results indicate that practitioners thought that impact methods can contribute by bringing out people’s potential as co-designers, doing the right thing, and making strategy actionable.

A major benefit the participants saw is that the methods bring out people’s potential by strengthening teams and supporting collaboration and inclusion, creating alignment, and making teams more proactive. For example, Impact Mapping and tracking of backlog and features to overarching goals, can facilitate integration of a development effort in a bigger picture, thus contributing to a culture where collaboration and joint problem-solving is valued. The methods also improved goal alignment between internal and external stakeholders. Functional silos could, at least

momentarily, be disregarded. As a result of seeing the bigger picture, team members were perceived to become more proactive.

Participants thought that impact methods could aid in focusing on doing the right things in the project. One example of that is that they facilitate in telling “hygiene factors” from “wow factors” by classifying deliverables into “necessary/base functionality”, “expected/requested functionality”, and “attractive/unspoken functionality”. Having proactive team members and stakeholders were also thought to lead to better understanding of the business as well as the user behaviour designed for, which in turn meant considerable reduction in defects and bugs. The hierarchical maps that visualize the value for different stakeholders were found to facilitate cost–benefit analyses, since deliverables in the map can be cost-estimated and weighed against the business value of the impacts in relation to effects goals. Another challenge in many projects is knowing what to build when. While agile project management methods such as Scrum encourages prioritizing the backlog based on business value, few (if any) recommendations are made regarding how to determine that value. As a result, backlogs often have many things to do at the same level of priority, and the deciding factor will instead only be the time it takes to implement. Participants thought that impact methods can replace detailed backlogs and specification, by instead offering a framework in which the design team can improvise ways to achieve the goals and question underlying assumptions of user stories and features, thus reducing development time.

Even the most well-thought-out strategy can be hard to implement. Participants said that impact methods and their mapping techniques can aid in making strategy actionable, by means of the chain-of-reasoning connecting deliverables and actions to strategic goals. Stakeholders can argue for features during workshops by using the effect or impact map. This means that communication is supported, and they remind people about the overarching purpose of the work. Participants also mentioned that a map also can be used as a narrative tool, telling stories about individual users through the perspectives of personas/user groups and scenarios.

3.5 Comparison of Impact Methods

Even though participants had not worked with all methods, they some understanding about the ones they had not worked with. Different impact methods were considered suitable for different kinds of projects by the particpants. Table 1 offers a synthesis of practitioners’ statements about the impact methods.

Unlike Goal Managing and Effect Managing, Impact Mapping focus on moving ahead fast and figure out which ideas work, and which do not. Practitioners of Impact Mapping were said to often be product owners and managers, not UX or service designers.

Of the three impact methods, Effect Managing appears most strict and technical for the purpose of using the maps for subsequent evaluation of solutions. Goal Managing gives more leeway in how to work. The defining characteristics of Impact

Mapping are not research and well-founded arguments but rather fostering productive conversations, visualizing goals, and quickly creating alignment around them.

Table 1 Comparison of participants' views of impact methods.

	Effect Managing	Goal Managing	Impact Mapping
Suitable for	Digital services and apps	Service design projects	Agile development and change management
Used by	Organizations that prefer well-defined procedures and extensive user research	Organizations that prefer well-defined procedures and extensive user research	Agile organisations
Defining Features	Relatively strict conventions to model, predict, and evaluate outcomes	Loosely defined with ideas from service design, e.g. journey mapping	Fast and iterative with a focus on collaboration and alignment
User Modelling	User groups modelled around behaviour	Personas with multiple dimensions and scenarios	Offhand approach to UCD and can be seen as advocating manipulating users
Stakeholders	Does not consider stake-holders other than end users	Other stakeholders through secondary and shadow personas	Takes stakeholders into account
Structure	Traditionally based on initial research	Initial or iterative user research in parallel with implementation	Organic and less work up-front

4 Discussion

We found that all impacts methods focused on the desired outcomes and effects of the design project. The methods also used a particular kind of objectives tree (Cross, 2008; Jones, 1992) that included the users and other stakeholders, and that connected overarching values and business outcomes with the desired effects for users, all the way down to features of the product or service. Effect Managing, Goal Managing, and Impact Mapping have differences in theory, and in the interviews they were characterised as suitable for different situations but given this limited study it is difficult to say what the differences are in a more general sense within practice. The participants in our study were pragmatic and picked methods and techniques they liked regardless of where they came from or what they were called. This makes it difficult to make any definite claims about how the three approaches differ. The results indicate that there are four conceptions of impact methods: (a) having clear goals; (b) designing for user needs; (c) linking user benefits and features to business benefits, and (d) a way of thinking about problem-solving.

Orlikowski and Hofman (1997) state that "change is typically an ongoing process made up of opportunities and challenges that are not necessarily predictable at the start" and suggest that managers give up command and control. They encourage management to create an environment that facilitates improvisation, referred to as cultivation, and liken it to a jazz band that jams together without sounding discordant.

Based on our results, it appears reasonable that by organizing around transformation goals using impact methods, instead of strictly following plans, teams can achieve a higher level of collaboration and potentially also workplace satisfaction. While Orlikowski and Hofman (1997) suggest that managers give up command and control, Simon (1996) assume that transformation is manageable. In our results, the conceptions of using impact methods differ in relationship to manageable transformation. Conceptions A and B, having clear goals and designing for users' needs, work as devices for coordination, they do not necessarily make transformation manageable, but opens up a space for control. Conception C, linking user and business benefits, aids in making transformation manageable, works as devices for coordination, and requires collaboration. Conception D, a manner of problem solving, works as an informal means of articulating an expertise, which requires coordination with other expertise, and does not contribute to a higher degree of manageability of transformation.

4.1 Criticism of Impact Methods

Impact methods use cycles of internal discovery and external validation to consider what is known and then going out to validate it. A reasonable modification for improved rigor would be to attempt to falsify the assumptions. In the cases where impacts are validated using quantitative research methods, it would indeed raise the validity of the work.

Effect and Goal Managing also take a limited view of the possible outcomes of a project. The impact map, as proposed by Ottersten et al. (2007), focuses on the intended positive effects. But transformational projects can also have negative side-effects (Hertzum & Simonsen, 2011a; 2011b). Actively assessing benefits in order to identify unrealized benefits, as well as 'disbenefits', which have been realized unintentionally, can be a good practice (Ward & Daniel, 2006).

4.2 Limitations

This study is small, and the interviews allow us to elaborate on a few experiences of the methods. It builds on interviews with ten practitioners from primarily Swedish companies, and three of them are with the originators of the methods. The results describe their idiosyncratic experiences, and any general conclusions should be drawn with circumspection. It is likely that the results would have been different with other participants from other contexts. No observations were made, and the results reflect how participants talked about their understanding of the methods and their experiences of using them. It is not unlikely that actual practices differ from what the participants said.

4.3 Significance

The perspectives accounted for by UX practitioners connects design and business specifically in IT design, but we would argue that impact methods also have the potential to be a driver in strategic design and transformation design more generally, by facilitating the identification of what changes to make for whom. Impact methods would accordingly be valuable additions to a designer's toolbox. This study indicates

that practitioners pragmatically choose tools and methods based on fit, why a larger toolbox is an asset. Impact methods are gaining adoption in Sweden, in design and development of both public and commercial services, and we cannot see any reason why they would not be useful in other contexts.

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Implications for Transitions to Sustainable Consumption: Finding Millennials' Behaviour Archetypes

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TRANSITION to a more sustainable consumption continues to be a challenge. In this paper, we explore socio-cultural conditions as a basis for proposing a radically different way of scaffolding the consumption of reacquired (second-hand) goods among millennials. In-depth interviews with fifteen young people, aged sixteen to twenty-seven, were conducted to uncover their lifestyles and aspirations, as well as existing practices concerning acquisition and disposal of consumer goods. The analysis reviled that all participants experienced their lifestyles as transient. Having that in common, we found three distinct consumer behaviour archetypes that guided their consumption practices: *Spirited Nurtured Dwellers*, *Busy Frugal Nomads*, and *Steady Independent Movers*. Identification of archetypes and their characteristics opened novel opportunities for the design of a future digital service that caters to each archetype and provides for positive frictions between them. Finally, we outline how our findings relate to the transition design framework that guided our research.

Keywords: transition design; sustainable consumption; consumption behaviour archetypes; social practice; local communities

1 Introduction

Digital technologies are readily designed, developed, integrated, and employed as a means of meeting growing global challenges. Among those challenges, social ones are increasingly visible, leading to the fast spread of technologies for social innovation, motivated by the desire to meet changing social needs. Even so, digital technologies that are presently available still showcase results of traditional information technology development pathways, often missing deeper entanglements with socio-cultural matters. Therefore, mitigating complex challenges with socio-cultural roots, such as the challenge of overconsumption among millennials that is addressed in this paper, calls for an alternate, design-led approach.

Design, interpreted ontologically, as an ongoing interaction between understanding and creation, finding and making (Owen, 2007), a conversation about possibilities, also shifts the understanding of what is designed: *"… every tool, every technological solution becomes ontological in the sense that, however humbly or minutely, it inaugurates a set of rituals, ways of doing, and modes of being (Escobar 1995). It defines what it is to be human"* (Escobar, 2018, p. 110). In other words, humans and their tools are mutually co-shaped.

Recently, the emerging transition design is gaining traction as an alternative to traditional means of designing (Escobar, 2018; Irwin, 2018; Tonkinwise, 2015). Although still mostly a theoretical and political proposition, transition design is a promising approach that explicitly considers sustainable and forward-looking design, envisioning more desirable futures than the probable ones should the traditional technology design approaches persist. Avoiding short term solutions, and unsustainable development is especially relevant for social innovation, where the typical for-profit nature of innovation combined with techno-enthusiasm, continues to leave little space for broader integration of the socio-cultural and sustainable perspectives. Therefore, understanding how to apply transition design to design of digital solutions for social innovation emerges as an area of relevant inquiry, to which this paper aims to contribute.

In the present paper, we describe the initial, sense-making phase of a real-life collaborative project with several large industrial partners. The project was concerned with the inquiry into the potential of peer-to-peer markets and reacquisition to mitigate overconsumption and provide mainstream, sustainable alternatives. We approached the project through transition design and focused on consumption patterns of millennials. They are about to inherit massive environmental and societal problems, with overconsumption as one of the central ones. Rather than fearing dystopian futures, some of these young people are getting engaged in creating alternatives to established consumer practices, e.g., (Peyer, Balderjahn, Seegebarth, & Klemm, 2017), but these alternatives are still far from being mainstream. An additional reason for choosing millennials is that they often become essential influencers for other age groups (Prensky, 2001; Selwyn, 2013).

Departing from the linear order of dissemination of academic results, we first published design practice outcomes, a future-oriented service for social innovation, both as an exhibit/installation showing a range of conceptual proposals and designed artefacts (Srivastava, 2017), and as an academic design research paper (Srivastava & Culén, 2018).

In this paper, we discuss the most challenging step - how to initiate and direct research on transforming the *throw-away* culture, while consistently thinking ecologically and including social, cultural and sustainability perspectives. In particular, we aimed to understand the way millennials tackle culturally embedded desire to (over)consume and the contradicting need to act sustainably. The research resulted in proposing consumption behaviour archetypes and amongst millennials and linking it to design for a transition towards decreased consumption. The behaviour archetypes are to be understood as behaviours, carried forward from deep historical roots that anchor socio-cultural norms. Thus, in contrast to the understanding of archetypes used in psychology, e.g., Carl Jung's work where archetypes are seen as invariant, we subscribe to a culturally-coded view, in line with work by (Megehee & Spake, 2012; Woodside, 2010), in which archetypes are understood as iconic representations of social meanings and behavioural norms. After discovering the archetypes, personal narratives of millennials that we worked with were anchored, and allowed for re-coding of existing views using transition design, and resulting in the future service proposal described in (Srivastava & Culén, 2018).

Methodologically, the inquiry took the form of in-depth interviews with fifteen young people aged from sixteen to twenty-seven. We inquired into their lifestyles and the relationship between lifestyles and consumption of durable consumer goods, as well as how they construct narratives around this relationship. Furthermore, we were curious about how *things*

(material possessions) shaped and supported their lifestyles, outlining at the same time their motivations, aspirations, needs and limitations.

The analysis of interviews uncovered how millennials engage in practices of acquisition, use, and disposal of everyday things. While living transient lifestyles represented an essential common thread among the participants, the practices of acquisition and disposal differed and led to the emergence of three distinct consumer behaviour archetypes: *Spirited Nurtured Dwellers*, *Busy Frugal Nomads* and *Steady Independent Movers*. A deeper understanding of consumption patterns represented by archetypes was essential for assessment of new opportunities, their alignment with principles of transition design, and ontological positioning forwards conversations regarding possible future lifestyles, featuring an increased sense of wellbeing and reduced dependence on (and motivation for) consumption of new, first-hand consumer goods.

In what follows, we first outline the background work that helped us to position and frame our research on transitioning to decreased consumption of new consumer goods among millennials. We then discuss the findings from the interviews, the behavioural archetypes and underlying dynamics and beliefs regarding acquisition and disposal of goods, and challenges related to reacquisition services. Finally, we outline implications for transition design, within the context of digital reacquisition, as a service for social innovation featuring possible trajectories for transitions regarding new lifestyles, patterns of use of everyday things, local connections, and community building.

2 Background

In this section, we provide a very brief background, divided into three parts, on the previous research and central papers that helped to shape this work: 1) transition design, 2) social practice theory, and 3) sustainable consumption patterns and practices.

2.1 Transition Design

Transition design (Escobar, 2018; Irwin, 2015; Irwin, Kossoff, Tonkinwise, & Scupelli, 2015; Manzini, 2015) advocates the re-conception of entire lifestyles, based on a deep understanding of underlying *systems dynamics*, aiming to make them *place and community based* (Escobar, 2018; Manzini, 2015). In proposing transition design, Irwin states that the success of needed, broad transformational change *"will depend upon our ability to change our ideas about change itself – how it manifests and how it can be initiated and directed"* (Irwin, 2015, p. 234). The approach, see (Irwin, 2018), forwards four main areas in which design and research activities unfold to scaffold transitions in a positive direction. These are 1) *visions* of the future, 2) finding and using the appropriate *theories of change* to build on established understandings of social transformations, 3) understanding both the internal and the external *values*, *influences*, *imaginaries*, *attitudes*, *mindset*, and finally, 4) discovering and using *new ways of designing*. The latter demands an *ecological literacy* and focus on materiality in relation to sustainability, as well as re-thinking social innovation beyond commercial interests related to new products or services. Starting from this theoretical framework, we aimed to discover real-life opportunities for place-based social innovation that scaffolds more sustainable consumption of consumer goods among millennials.

To transition from existing to local, place-based and situated consumption practices, we worked with the social practice theory as a theory of change.

2.2 Social Practice Theory

Social practice theory conceptualises human actions and the ways people conduct their everyday lives in terms of their routinised behaviours, or practices (Ingram, Shove, & Watson, 2007; S. C. Kuijer, 2014; Shove, Pantzar, & Watson, 2012; Wakkary, Desjardins, Hauser, & Maestri, 2013). In (Shove et al., 2012), the authors deconstruct practices into three constituent elements: *materials* (e.g., ecologies of things, built environments, infrastructures), *competences* (learned routines, know-how) and *meanings* (shared ideas, meanings, visions). Variations in these elements create opportunities to frame, to design, new practices - *proto-practices* (Julier, 2007; L. Kuijer, Jong, & Eijk, 2013; S. C. Kuijer, 2014).

Choosing the social practice theory as a theory of change in our transition framework allows reframing reacquisition and reuse as socially constructed proto-practices that can lead to positive change in consumption patterns. Furthermore, consumption behaviours have been previously discussed in the light of social practices, e.g., previous work (Ingram et al., 2007; Julier, 2007) has been instrumental in shaping our service proposal (Srivastava & Culén, 2018).

2.3 Sustainable Consumption Patterns and Practices

Lastly, focusing on the sustainability of consumption practices, we turn to work by Pierce and Paulos, (Pierce & Paulos, 2011), who discuss consumption and frame it as activities related to acquisition, possession, dispossession and reacquisition. The authors explored reacquisition (purchasing used, second-hand goods) in particular, as a possible pathway towards more sustainable consumption. They point to the important distinction between designing *for* or *with* communities of reacquisition, and designing *from* communities of reacquisition. The former has to do with improving reacquisition as practices by using better technologies, services, or deepening the environmental concerns. The latter, on the other hand, engages in processes and practices of reacquisition as the basis for seeking and shaping of radically different solutions. Emerging from communities, it is naturally related to social practices and justifies our choice of designing for transitions using social practice theory as a theory of change. Pierce and Paulos's rich qualitative study of reacquisition informed on the importance of values, and social acceptance. They also pointed to some important challenges with current practices of reacquisition. Furthermore, their work brought attention to the relation between dispossession and reacquisition and the importance of experientially desirable solutions for both.

In (Odom, Pierce, Stolterman, & Blevis, 2009), authors discuss dispossession and reacquisition. They focus on the meaning of things in everyday life and outline four areas of importance: engagement with things, stories and memories that things invoke, augmentation (creative ways to use things, enhancing experiences) and perceived durability and quality.

From the sustainable marketing thinking perspective, we point to the paper (McDonald & Oates, 2006) that aimed to understand consumers from the *green thinking* point of view and understand why green thinking did not take more massive proportions.

3 Method

We chose a qualitative approach, based on semi-structured in-depth interviews, aiming to 1) inquire into existing consumption practices among teens and young adults aged 16 – 27, and 2) to explore implications for transition design and alternative approaches to scaffold transitions to more sustainable consumption.

Fifteen participants (recruited by posting campus-wide announcements, and providing a small payment for the participation) were interviewed. Seven participants were male; eight were female, see Table 1. The interviews lasted for at least one hour, most taking close to two hours. They were recorded, anonymised, and transcribed. Emergent, thematic coding was used to analyse the transcribed content. The analysis started with the independent coding of two randomly selected interview transcripts by each of the authors. The emerging themes were then discussed to guide the remaining work with the content analysis.

The interviews did not focus on sustainability or transition. Rather, they focused on lifestyles of participating youth, and the existing practices of acquisition and disposal, in line with (Odom et al., 2009; Pierce & Paulos, 2011). The resulting themes were grouped into two main categories: consumers' behaviour archetypes, treated in this paper, and implication for the design of the new digital redistribution platforms aiming to re-position digital second-hand markets in line with transitional thinking, described in (Srivastava & Culén, 2019).

Table 1 Gender, pseudonyms, and the age of participants

	Gender	Pseudonym	Age
1	F	Dwelline-1	17
2	F	Dwelline-2	16
3	M	Dweller-3	17
4	F	Dwelline-4	16
5	F	Dwelline-5	16
6	M	Nomad-1	22
7	F	Nomadine-2	21
8	F	Nomadine-3	21
9	M	Nomad-4	19
10	M	Mover-1	27
11	F	Moverine-2	26
12	F	Moverine-3	24
13	M	Mover-4	24
14	M	Mover-5	24
15	M	Mover-6	26

4 Findings – Behavioural Archetypes

The analysis of participants' habitual consumption behaviours and experiences with them highlighted the transient character of their living situation as the most influential factor in shaping their consumption patterns and purchase decisions, such as buying brand new or second-hand goods. Based on these patterns, we outlined three behavioural archetypes representing the broad understanding of the nature of their living arrangements. These were named Spirited Nurtured Dwellers, Busy Frugal Nomads, and Steady Independent Movers to communicate the main lifestyle characteristics underlying the consumption behaviours. Among the recruited participants, the youngest ones all lived with their parents, the students lived in student housing or collectives, and the oldest participants lived on their own (or with a partner). Thus, for our participants, the age and the living arrangements happened to align perfectly. This alignment is culturally conditioned. In Norway, it is less acceptable to stay at parents' home after graduating from the high school, and it is common to get one's own place after graduating with a degree from the higher education.

We now discuss the consumption patterns of each archetype in turn.

4.1 Spirited Nurtured Dwellers / Dweller Archetype

The participants in this category were all very spirited teens, nurtured by guardians who house them and (still) carry the legal and financial responsibility (as the oldest participant in the category was 17) for them. This implies that they had only a partial ability to make own purchasing decisions, especially on larger things. They were responsible for shaping their dwelling places (largely consisting of a single room) but had little or no influence on purchasing decisions for the rest of their homes. Their incomes came from monthly allowances, monetary gifts received on special occasions, or small jobs around the house, the neighbourhood, or other part-time paid work. This income allowed them to manage most non-essential purchases on their own. Regardless of the financial background of their families, all participants had some monthly income available and were motivated to make efforts to earn extra for things they desired. They were mindful of opportunities to do so.

Dwelline-1 did not hesitate to acknowledge the influence peers had on her decision to work part-time, as well as on her desires for new things.

"I just felt like I didn't have [enough] *... My parents didn't give me more money, and I felt like every single one of my friends did have many things that I also wanted. I wanted to have them, the small things like theirs. That is why I wanted to start working.*"

Even on a limited income, this group preferred to stay in tune with trends and was strongly inclined to purchase new, first-hand goods. With this behaviour, the *use-span* of things they owned remained shorter than their *life-span*. Yet, the nurtured dwellers exhibited very limited and selective interest in acquiring second-hand things. Given their interest in new things, and the prevailing perception that online and other second-hand markets sell things that people put there by ways of *getting rid of undesirable things*, a *discarded* inventory, their engagement with second-hand markets, digital or not, was sparse or none at all. The encounters they had with the second-hand platforms as buyers were limited to the pursuit of collector's items or hobby projects. For instance, Dweller-3 was a hobby musician and bought a drum set online. He perceived the drum set as a collector's item because the item was sold by a famous musician. As reasons for the purchase, Dweller-3 pointed to these facts, the favourable price, and the perception that the previous owner took care of the instrument unusually well. Dweller-3 and Dwelline-4 also engaged with second-hand platforms to help their family members sell things that they did not use, need, or want any longer, in exchange for keeping the earned money either partially or in full. For them, this represented the way to earn some occasional extra income. It also re-enforced their perception of digital second-hand platforms as ways to get rid of unwanted things.

When asked if they would be open to purchase of used things, Dwellers said that they could be open to it under certain conditions, but apart from Dweller-3, they did not purchase second-hand. Dwelline-2 expressed the concern that the others raised as well, regarding the *safety and trust* as part of transactions involving second-hand goods.

"*I am going to university next year. I would gladly buy a used book if there were not too many scribbles and notes in it. I am open to the book purchase because the person that I would buy the book from would be a trustworthy student from the same campus I would go to"*

When asked why would she trust that student, Dwelline-2 said: "*I guess it is the age. It matters a lot."*

4.2 Busy Frugal Nomads / Nomad Archetype

Beginning to move out of their parents' home in the pursuit of higher studies or work, the *Busy Frugal Nomad* archetype is characterised by participants' fairly independent, studies-focussed and financially constrained situation. The participants themselves referred to this living situation as a *student lifestyle*. They discussed their relatively self-reliant way of living with a sense of pride, responsibility, and concern with staying within a *student budget*.

"No, I don't live at home anymore and I can take those decisions on my own [what to purchase]*. But when you have your own apartment* [shared] *and don't live with your parents, then you have to think a bit more about how you spend your money, especially when you are a student. Yeah, that's something I have to think about now"*, Nomadine-3 pointed out.

At this life stage, they feel that, if they want something, it is their responsibility to pay for it, although the help from parents is still acceptable (and often desirable).

"After I moved out, I have been ... I wanted to be on my own. If they [parents] *want to help me, okay, but I can work with my own money"*, Nomadine-2 shared.

The living spaces are often of the shared type, typically own room and shared kitchen, living room and the bathroom. Participants in this group decide on furnishings of their living quarters, but this time, keeping in mind the temporary nature of this arrangement, as well as the sharing that characterises it. Nomad-4 explained how he started to use the online second-hand platforms in this context.

"We bought everything [furnishing] *ourselves. That's when I started to go down to FIND* [the largest second-hand online platform, Finn in Norwegian] *to buy used furniture."*

The attitude toward second-hand goods changed among all participants in this group. They became more acceptable, mainly because of the price. However, it was interesting that the shared items were also decided on based by the smallest price tag. Talking about the piece of living room furniture, Nomad-1 said:

"It's cheaper on FIND, and I didn't have the money to buy new stuff. You can actually, find very nice things on FIND. Since we were going to share it between the three of us, we would just take the cheapest one."

Three Nomads said that they would have liked to bring things from their parents' home. However, this was not always possible. Some desired things that were too expensive to be used in shared *student lifestyles*, or it was too costly to move larger things to new places. In addition, none wanted to own things that they could not leave behind or throw away - just in case that, like *nomads*, they had to move multiple times, something that happens often. Therefore, all of them held a belief that inexpensive first-hand markets (such as IKEA), or *reliable* second-hand markets (implied either the online platform FIND, or the established and well known flee-markets) are best suited for this life stage.

Although they all have had experiences of purchasing second-hand goods now, the actual choices made reflect that cheap first-hand purchases are preferred over the second-hand ones. The explained this by their busy schedules and the hassles associated with second-hand markets (mainly the need for transportation of things, the need to make time to search for items and check the sales premises including the price and the photos to check for possible miss-representation of goods, difficulty in communication with sellers, etc.).

4.3 Steady Independent Movers / Steady Archetype

A transition towards becoming a steady independent mover comes with a realisation of study objectives and setting of the career goals. This brings about several lifestyle changes. For most of the participants, a full-time job and a higher *steady income* effectively eliminated financial dependencies on their families and constraints of a student life, including the necessity of living in shared spaces. Moving out of a shared living space and into more personal ones (on their own, with a close friend, or a partner), strongly influenced choices and patterns of acquisition of things, furnishings and personal belongings. Things that the participants aspired to own were now within their financial reach. Most of them disposed of things using FIND, which they believed was suited for shared ownership in a more transient living setup. That is, they disposed of things that were suitable for a Nomad archetype. Asked if they also bought from FIND for their new place, the preference for new things was strongly present. Moverine-2 and Mover-1 (respectively) articulated this as follows:

"New stuff, because it is now our apartment and not something that we have to share."

"I prefer to buy new things just because I don't deal well with stuff like going to particular places [to pick up things]*, which is time-consuming for me. I worry about more things than when buying new, like okay, is it clean, does it look kind of old, how well was it used – those things I don't need to think of if I go and get something new. Even if it's less expensive, I think that I value more the practicality of having new stuff."*

Even though the participants experienced more stability in their lives, their lifestyle often continued to be transient. Most needed to rent an apartment rather than buy one. They also stated that they wished to explore other work opportunities, leading to changes in residences possibly frequently. Mover-1 reflected on this:

"I do not need to own things, I prefer to keep moving and the things that help me in my work are the things that I really want to own and I usually invest more in them."

Mover-6 did not change the apartment as often as Mover-1, but points out that the things that he has are not perfect. When his life stops being in as much flux, he wants to make some changes. For now, it was OK to have and *hack* IKEA furniture.

"It is the same way with my bed. I'm noticing now, after 6 years that I've had it, it is becoming unbalanced. When I get my own apartment [owned, not rented]*, I need to buy a new one or a used one, but a good used one"* and *"I know that once I get a new place, maybe I'll start with it* [IKEA furniture], *but when I start to earn money* [more of it] *I will want nicer things."*

These situational factors often made well-functioning goods available for redistribution. None of the participants considered disposal as an optimal choice, but found it to be a convenient alternative, given effort-intensive experiences with current redistribution platforms.

Summarising, the three archetypes had in common inherently provisional living situations, although to varying degrees. The underlying transience was a key motivation behind the (mainly necessity driven) engagement with redistribution services within this demographic. Thus, we identified the opportunity to explore ways of scaffolding transience by envisioning different pathways for moving goods between the archetypes, creating, in addition, possible pathways for sharing experiences, knowledge, skills and time, within a familiar, similar-minded demographic. This held a promise to mitigate premature disposal of goods, as well as provide the foundation for local and community based social practices.

5 Implications for Transition Design

We approached the issue of consumption among millennials with a *posture of openness*: we wished to do a broad, open, reflective and exploratory inquiry into routinised behaviours, focusing on culturally embedded, archetypal understanding of youth and their consumption patterns and practices. Our own value system includes the ecological thinking and beliefs that design for sustainment and wellbeing does and should make transition designer to do inner work and consider a series of polarities, such as the individual and the communal, the embedded reflexivity and the abstract knowledge, design or non-design, as also discussed in (Escobar, 2018; Irwin, 2015). With this posture, we outline the implications for transition design that can contribute to wider uptake of second-hand consumer goods, and position the reacquisition closer to the mainstream practices among millennials.

5.1 Vision for Change – Repositioning Reacquisition for Transient Lifestyles

As evident from the interviews, the practices of possession and dispossession of everyday things, largely pivot around the state of flux and transient nature of the living situation of this age group. Drawing on the previous research (Odom et al., 2009; Pierce & Paulos, 2011) and our findings from interviews, reacquisition, and specifically digital services for reacquisition, have a potential to target this group much better by offering sustainable services that are appropriate for the lifestyles of millennials.

Instead of a generic approach that connects buyers and sellers today, offering a seamless point-to-point peer transaction, the reacquisition services should offer a holistic system addressing the material needs and challenges of the dynamic, aspirational, and busy lifestyles of this young demographic. Beyond strategies to nudge toward making greener and more sustainable choices (by, for example, extending the use span of goods), or monetary benefits, the vision for change builds on a reacquisition service that connects archetypal behaviours of peers with similar, familiar and recognisable needs, and rituals/practices around usage of their possessions, in line with their transient lifestyles. Articulating and communicating this vision through the service can help build the trust in the service. The majority of the participants in our study felt confident in exchanges with other millennials. Hence, the threshold to take the service in use, and keep using it, can be reduced.

5.2 Theory of Change – Social Practice Theory and Positive Social Frictions

As nearly all interview accounts pointed to, social interactions with sellers on digital second-hand platforms such as FIND were often deemed uncomfortable and undesirable by otherwise rather social millennials. At the same time, the participants admitted that impressions of and conversations with sellers on second-hand platforms were essential to shaping the attitude towards the object that they wanted to buy. Everything related to a specific transaction, starting from the way that a second-hand object is presented on a digital second-hand platform, email-exchanges with a seller, person-to-person meetings – it all mattered.

Thus, a sustained and positive social friction was identified as an opportunity to further scaffold trust and create familiarity in relation to the alternative peer-to-peer service. This is important especially for reacquisition, our data showing that the existing services were used only if and when there was a need, and infrequently. To change that, the future service should provide for other social frictions between users beyond simply buying and selling by creating alternate opportunities for positive social interactions between peers, based on building multiple small, local and engaged communities. For instance, reacquisition market

platforms could actively support local DIY fixing events, function as an assistive forum for the young millennials settling down as newcomers to the neighbourhood, or offering reviews on second-hand values and lifespan of various goods. Thus, we envision that new social practices can be designed (L. Kuijer et al., 2013; S. C. Kuijer, 2014) to support more frequent and sustainable exchanges not only of second-hand goods but also knowledge and experiences through these positive social frictions.

5.3 Value – Pathways for Movements of Goods to a New Context

Pierce and Paulos (Pierce & Paulos, 2011) emphasise contextual situatedness as something that can re-code the value of any object, claiming that everything has the potential to be valuable in some context. The pivotal position of the context was also evident in our research. For instance, Dwellers liked to keep trendy. Their things rarely used up their life-span, yet Dwellers did not show an inclination to engage with meaningful disposal. This is in line with their context of being nurtured. However, with some effort, they could be passing their goods to Nomads, who did not show much care for trends and where the price tag was the most important. Building on this, we explore the agency of design to envision robust pathways for the movement of durable goods across meaningful contexts, see Figure 1. The interviews, especially the use patterns of Movers, indicated that sustained patterns of moving goods to Nomads could be beneficial. We argue for designing the path of reacquisition by connecting peers with complimentary lifestyles as well as familiar routines of use as one of the main value statements that express well both our own values and intent with design, but also bring value for millennials.

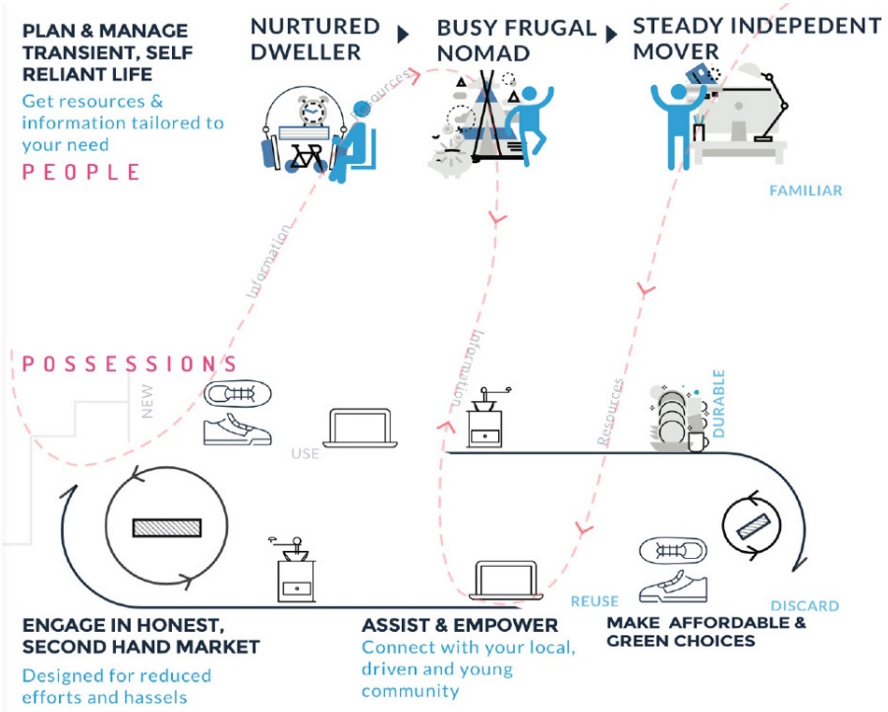

Figure 1. Connecting archetypes by reacquisition pathways and placed based, active, and young communities.

5.4 Value – Mitigate the 'Easy Riddance' Reputation of Second-hand Markets

Reacquisition needs to be designed and branded in ways that remove the reputation of second-hand markets as being platforms for *getting rid of unwanted things*. The subtle inclination of these services towards selling as opposed to buying, through narratives and systems interactions encourages the use of these platforms as a convenient disposal

strategy as well as a source of cheap throwaway goods, countering the intent of reducing consumption. Instead, reselling platforms need to be designed to adopt and promote the narrative of movement and circulation of treasured stuff rather than *getting rid of unwanted things*, where the community views the goods as a representation of their intents, practices, and aspirations.

Additionally, by positioning the service as a clear and defined platform for mainstream utilitarian goods for the younger population with a transient lifestyle, the quality standards of the service can be tailored towards care, share, ease, and transparency in touch points between the millennials and the service.

Taking into consideration the above findings and their implications, we have used a combination of systemic thinking, research through design, service design and branding to propose a new way of designing future second-hand marketplaces for millennials (Srivastava, 2017; Srivastava & Culén, 2018).

6 Conclusion

Across archetypes, socio-culturally shared attributes of millennials' lifestyles show essential similarities and differences. The most important similarities, in terms of implications for transition design, are the transient nature of lifestyles and a strong preference for new goods despite deep awareness of issues around sustainability. Together, these define millennials as a population in need of a radically different service, supporting transience and more sustainable living. The differences among archetypes supported a conceptual mapping of distinct and sometimes oppositional categories of consumption behaviours that could serve as a basis for charting future, elaborate and flexible pathways along which goods, skills, knowledge and meanings could flow. Finally, narratives encoded by consumerism and mass acquisition need to change to incorporate new values and visions, distinct from *cheap* and *riddance* and create iconic behaviours based on care for things, people and the planet.

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Inherent issues in Japan's integrated fiber production areas and the role of the designer in cross-sectoral collaborative production

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The textile industry is declining in many developed countries. Restoring it requires the collaboration of craftsmen, designers, engineers, and managers. Among these, the role of the designer is key: the designer understands all production processes and is responsible for deciding on the final product. This paper examines the results of a survey carried out in Kiryu City—Japan's apparel industry agglomeration area—from a practical viewpoint. Its uniqueness is the public fiber research institute, which offers significant potential for industrial continuity and innovation on a global scale. The survey reveals that collaboration with local companies has not been initiated, and uncovers the causal factors. Based on its results, the development of continuation is examined. This research finds that the most important factor is the industrial form in different fields. The purpose of this study, thus, is to contribute to the sustainability of production areas in similar situations.

Keywords: textile industry; design; cross-sectoral collaborative production

1 Introduction

In recent years, the textile industry has been steadily declining in many developed countries such as Italy and Japan due to the rise of fast fashion and the associated growth in mass production systems in less developed Asian countries. However, despite economic difficulties, the Japanese textile industry has been highly valued for its quality (Ministry of Economy, 2019, p.14) and the level of export value is still high in the world (Figure 1). As a measure to prevent its decline, in such situations, subsidies are being actively implemented in each production area in line with administrative policies as outlined in 'Creation of local brands' (Ministry of Economy, 2017, p.4). While success and failure stories differ significantly by the place of production, there are few cases in which the factors contributing to this difference are logically clarified. For the sustainable development of this industry, it is important to clarify the strengths of each production area as well as their inherent problems, and to propose solutions accordingly. It is also important to objectively examine the role of the textile designer, who devises the form of the final product and grasps all the processes, as the industry has many factors that add value. This shift in technology is a common problem in all areas of design. It is claimed that the technology will be weeded out and those that will remain should be appropriately considered (Pekka,

2010). However, as evidenced by the fact that more factories are closing almost every month, the speed of change due to economic circumstances is high, and technology and human resources that cannot be replaced by machines have disappeared. In addition, there are very few cases in which the present situation and problems of production areas have been investigated by objective methods from the

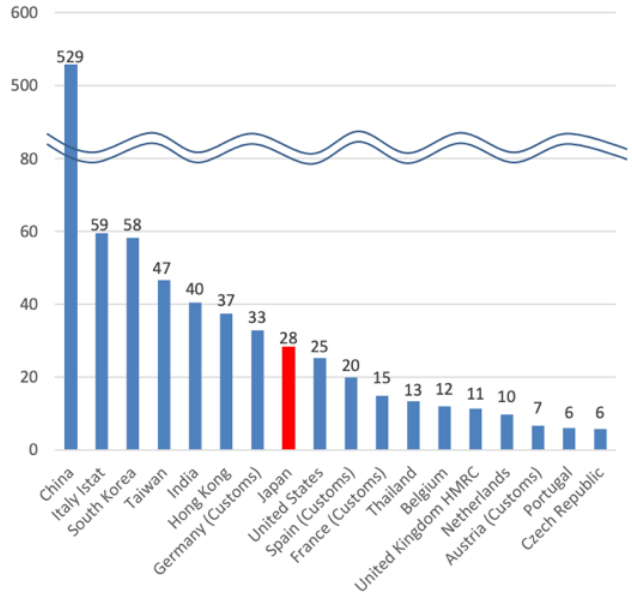

Figure 1. export values of woven fabrics in 2017. Source: Global Trade Atlas

Figure 2. The map of Kiryu city in Gunma prefecture

viewpoint of design science. Several studies have been conducted from a business perspective, but no objective consideration has been made from a design perspective. However, problems that involve production areas are basically complicated by the domestic situation and are very difficult to grasp from outside. This is the reason there are few examples of research that goes beyond the intrinsic issues. In this study, the author, as a designer, was invited by a private organisation committee in the Kiryu production area (Figure 2), and discusses the issues that have been observed both inside and outside. Previous studies show the clear decline in Kiryu, the size of production has been reduced to less than 1/4 in 30 years (Kawamura, 2016). The investigation of this research project revealed more practical problems and intrinsic factor, and it was possible to examine the practical direction of the possibility of producing districts. It is emphasised that human resources with a practical background of design should consider this matter with objective logic, which will be an effective way to share a sense of purpose in future industries where collaboration among different fields is essential. Therefore, this paper examines the role of designers, elements of 'handwork' of craftsmen, positioning of intuition and experience values, and future prospects of them.

2 Method of investigation

The following methods were used for this investigation (Kiryu City Chamber of Commerce and Industry, 2018):

a. Questionnaire

b. Hearing interview
c. Field work

2.1 Questionnaire

The purpose of the questionnaire survey was to understand the current status of production and sales of textile companies in Kiryu City. It was mailed to 356 textile companies, and 58 responses were received. Figure 3 shows the categories and distribution of companies that responded to the questionnaire.

Figure 3. Categories and number of companies that responded to the mail survey

The contents included ‘business contents’, ‘handling materials and techniques and products’, ‘processing and special technologies in which we excel’, ‘type of production’, ‘status of development and production of in-house products’, ‘issues related to the development of own products’, ‘product design policies’, ‘willingness to participate in seminars on branding, market development, and PR strategies’, and ‘free description’.

2.2 Hearing interview

The purpose of the hearing survey was to visit businesses directly to objectively understand business conditions and technological strengths, which are difficult to gauge through paper questionnaires.

The types of businesses of enterprises in the city that conducted the hearing survey are classified into the following categories (1) to (8).

1. Large-Scale mass-production textile industry
2. Medium-scale mass-production textile business that functions as a cooperative factory
3. Small- and medium-scale textile businesses that specialise in special technologies and materials
4. Dyeing and processing industry
5. Production of nits
6. Race production
7. Traditional craftsman
8. Public Research Institutes

2.3 Fieldwork at Joint Enterprise Exhibition

In addition to the above, fieldwork and interviews with company staff were conducted. In the joint exhibitions held in Tokyo (Japan Creation and Kiryu Textile Promotion) with the participation of several companies in the city, and the Fashion

Week held in the city in November 2018, the author had the opportunity to talk directly with companies in various business categories.

3 Result

The results of the questionnaire survey indicated that an overwhelming majority of businesses in Kiryu City are engaged in processing textiles and textile products. Both the apparel industry and the textile industry have been facing severe market conditions in recent times, and the production area functions that the leading integrated production areas of the Japanese textile industry can shoulder, are entering an important phase and require fundamental reconsideration. The survey results are discussed below, followed by their implications.

3.1 Diversity of technological capabilities and challenges

In considering the diversity of technological capabilities, the results of the questionnaire survey focused on the following two points.

1. Businesses necessary for all stages of product production, from planning and production to arrangement, dyeing, processing, and sewing, are concentrated in the city.
2. There are two types of manufacturers in the production area: one is a company that mainly receives orders from original equipment manufacturers for mass production, and the other is a company that produces many kinds of products in small quantities using advanced handicrafts such as traditional craftsmen.

First, (1) suggests the possibility of production that is beneficial for both B2B and B2C enterprises. Unfortunately, at present, there is almost no basis for cooperation within production areas (except for cooperation with some cooperating factories). Through interviews, it was found that information sharing among different industries is inactive. However, those who were interested in developing their own products were also aware of the necessity of cooperation within the production areas. In particular, Kiryu City has Gunma Prefectural Textile Industrial Laboratory capable of developing leading-edge materials which may lead to an industrial form that is differentiated from other production areas. Currently, the center has cooperative relationships with other companies, such as for commissioning quality tests for product materials and joint development projects. It is a rare environment where there is a public organisation in which doctoral researchers conduct material development research, and businesses that can implement and verify research seeds are concentrated on the same land; this should be positioned as a regional characteristic that should be utilised to the maximum in the future.

The result of (2) explains one aspect of ‘Diversity’ which is Kiryu’s strength. After World War II, business operators mainly producing western-style clothing were grouped into mass production type, and those which developed from business related to traditional Japanese clothing (Kameda, 2011), where handicrafts and the skills of craftsmen were valued, were grouped into handicraft production type. During the survey, comments such as the following were common: ‘Requests rejected in

other production areas are sent to Kiryu production areas'. The attitude of prioritising texture and expressiveness regardless of time and effort was common irrespective of the industry, showing a high level of awareness for the improvement of manufacturing quality. In one case, the loom itself was remodelled by a craftsman just to weave a special metal thread. Technologies for mass production, which can ensure stable speed and quality, do not necessarily match those for small production, which emphasises expressiveness and texture. In Kiryu production areas, it is possible to flexibly select production methods according to the purpose.

3.2 Technology succession and production scale differentiation

There was a large difference in the direction of the method of transferring production technology depending on the scale and content of each office. In the large-scale mass-production type factory, the mechanisation of technology was promoted to cope with the employment of young human resources. For example, the latest large rapier loom manufactured by *Dornier AG* of Germany can be operated by young employees because it automatically controls the handling of thick numbers and special yarns that otherwise require the skills of expert craftsmen. On the other hand, small- and medium-sized enterprises (SMEs) often still depend on the skills of craftsmen. Skilled workers' ability to respond and provide high-quality proposals are their strengths, but there were also comments that it was difficult to hire successors and secure teaching hours. As the position of craftsmen is changing due to the introduction of IT, it is necessary to consider an environment for human resource development that can distinguish between the techniques of hand and 'sensation' of workers to be inherited and the skills substituted by machines, as well as to acquire them.

4 Discussion

'Examination of intervention positions and methods of design human resources (Positioning of Design (design quality) in Product Planning)'

The objective of this project is to plan and produce products that make the most of the seeds in the production areas and to send them to the world market. The most important elements are 'Branding' which was the theme of the workshop, 'Story' which is the background of the product, and 'Design' which determines 'colour and shape' that appeals to the sensitivity of consumers. The results of the questionnaire survey and interviews have a common feature, that is, there is a remarkable tendency to answer that the problem is the 'market' when working on in-house product development.

The factors behind this trend are discussed here. One of the reasons is thought to be the development of division of labour in Japan. It is one of the differences from the European factory that has its own designers. While some companies employ their own designers to build original brands, many companies place importance on developing sales channels before proposing product designs, and awareness of design issues varies greatly among companies. The rich variety of technology makes it possible to develop products with a high design quality, and it can be said that it is

a key to the branding of Kiryu production areas. If product design is carefully examined according to the target, development examples are repeated, and awareness of design issues is shared, then production that appeals to highly sensitive consumers may spread in production areas.

5 Conclusion and implications

In the conclusion of the expert committee for this project, the establishment of an organisation to objectively design evaluation and quality standard evaluation was mentioned as a major step toward the solution of problems in production areas. It is possible that creating an environment that includes the following functions (A-D) will help develop the basis of a new type of project to promote textile production areas. Gunma Prefecture has committed to providing full-scale support to SMEs in the development of functional fibers for the medical and health sectors to promote 'medical and healthcare industries', which is one of the priority areas. Specifically, the Ministry of Economy, Trade and Industry will introduce equipment at the Textile Industry Experimental Station in Kiryu that can analyse processing conditions, such as concentration, temperature, and time of chemicals.
If the following functions are adopted, then a more solid production platform can be created.

A. Human resources and equipment for the development of advanced materials and processing technologies/Gunma Prefectural Textile Industrial Laboratory

B. Demonstrative production of A, various technical skills to realise the proposal of C/Textile companies in the city, traditional craftsmen, etc.

C. A, B, and other seeds from other production areas are connected to propose highly sensitive products/design human resources, coordinator

D. Product Marketing/PR Strategy Talent
Management and utilisation of design materials as design resources
Human Resource Development (technology succession)

Finally, before World War II, in the Kiryu production areas, trade unions and local governments played an important role in the transition from the quantitative expansion period to the qualitative improvement period as a mechanism for effectively functioning innovation in the production areas (Hashino, 2016, p.53). It is expected that this project will be an opportunity to reconsider the function of the trade association. It is considered that human resources with a practical background of design can share their understanding on the research objective by considering the problems and prospects of production areas using objective logic. In addition, the author recognized that human relationships and power dynamics have a significant influence on the production area. These aspects may have prevented the acceleration of collaboration within the area in some cases, and it is assumed that such a phenomenon also occurred in other production areas. This tendency is thought to be influenced by the Japanese high-context culture. The regional cultural background and the actual state of the industrial system differ depending on the locality. To accelerate the project of local collaboration within production areas, it is extremely important that external human resources who are not excessively bound by the relationships peculiar to the region and human resources within the

production areas who are able to take these inherent points into consideration come and go. Japan's technological development capacity to add functionality to textiles is valued as is unrivalled by other countries (Matsushita, 2019). It is the author's sincere hope that a circle of cooperation will expand beyond the boundaries of generations, industries, and both inside and outside the textile producing areas, where 'the Japanese craftsmanship' is concentrated.

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Leadership Thinking for Design Discipline. Coaching how to Navigate between Potential DYNAMIC and Power ENERGY

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"Revolution" is defined in two different ways: first as a word used to explain the movement of a celestial body around the orbit and the period made by the regular succession of a measure of time or by a succession of similar events; second as a sudden outbreak in the accepted social norm, a fundamental change in the way of thinking and a change of paradigm[1]. While the former explanation has extensively been used to mark innovative technological progress, in the next paper we propose a different way of looking as revolutions in design education, not as sudden outbreaks but as cyclical adjustments to the reality of the working environment for which design education prepares the students. While the design market place and working habits changed radically in the last 20 years, the perception of the role of the designer in design schools didn't adjust accordingly.

The paper is therefore reflecting on the following question: given the uncertainty of the future and the, what is the role that designers are most likely to step-in? Starting from the assumption that the working space doesn't have physical boundaries anymore and designers have to re-invent themselves with each job, we speculate on the raising importance of teaching a leadership attitude in conjunction with practicing design skills from the first years of design training. To support this argument we will stress out how leadership implies projecting the potentiality of taking responsibilities, and preserve the creative energy, in contrast with the deployment of effort and skills intrinsic to the traditional design process.

Keywords: critical thinking, design education, empowerment, leadership, coaching

1 Introduction. From expressing to preserving creativity

Design leadership has been widely recognized as a strategy for the future of "advanced design" (Mozota, 2006), anticipating the role of the designer as an "interpreter" who assumes an advocacy role (Buccolo et al., 2012). Several literatures argue the importance of teaching design leadership as a competency at undergraduate and graduate levels (Baars & Rüedi, 2016) in order to draft and test new coaching strategies that will acknowledge the emergence a new role for the design professionals. Nevertheless, these concepts are difficult to be found in the undergraduate design education that still focuses on teaching skills

[1] Miriam Webster dictionary

without integrating components of leadership training nor challenging the traditional and somehow out dated system of thinking about the role of the designers in the industry.

In this paper we ponder on the potential of introducing the notion of design leadership from the very beginning of the design training. We firstly present the different levels of expertise from novice to master and visionary leader, secondly will report the findings on how a group of design students perceive the meaning of leadership in design and thirdly outlines the differences between “expressing” and “preserving” creativity. The survey was not intended to provide definitive answers but to change the rhetoric based on skills and expertise, and to provoke a discussion on the shifting role of the design professionals. In conclusion we argue that while “expressing creativity” was the norm for design education, the next generation of designers will primarily have to be taught to assume the responsibly to preserve creative resources, first of their own and then of their team of collaborators.

The importance of acknowledging the manifestation of power and authority and acquiring leadership competencies, has been discussed elsewhere by the authors (quote). This paper instead aims at re-adjusting the vision of design revolution widening it to include the concept of *preserving potentiality* in contrast with *expressing creativity*. In order to understand the validity of this assumption, and as an attempt to get closer to the younger generation’s way of thinking about design, the authors of this paper have asked a class of 30, 3rd year students in product design, a set of 10 questions regarding their understanding of design revolutions, the necessity of design leadership and the future role of designers.

As shown by Cross (2003) (2004), design expertise develops gradually in several steps. By crafting a personal set of skills and procedures, acknowledging the responsibilities implied by the leadership role, and understanding design leadership as a capability that develops in time and so requires an initial level of design expertise. Moreover in order to achieve master and visionary capabilities (Dreyfuss, 2003), it is necessary to first re-frame the role of the designers in organizations and look at them not as creative executors but as responsible leaders.

2 Design leadership, from thinking to mind frame.

Drawing from the above literature, the development of expertise is directly related to the level and perfection of the skills through continuous practice. Moreover, the examples brought by Nigel Cross, show accomplished designers that achieved the leading status by perfecting their skills, nevertheless the level of expertise doesn’t necessary relate with the leadership capabilities of experts. While design leadership requires a thorough understanding of the design process, we argue that the skills necessary to develop and assume a leadership attitude are not necessary related to the level of expertise. In the next chapter we review the design thinking literature, showing how design thinking is grounded in the practice, but in the mean time suggesting that the design leadership mind-set has to be equally integrated in the design practice.

2.1 Thinking grounded in practice.

Design thinking literature, has so far concentrated on designers’ skills and their ability to adapt to the brief practicing their skill and knowledge to generate the most innovative solutions. This perspective concentrates on the professional expertise acquired through practice and has at its core the relation between designers and clients or client organizations in a demand and offer dynamic mediated by the design brief. The working process and

design thinking patterns of exceptional designers has been researched by Nigel Cross and focuses mainly on designers and architects leading their own private practices (2003, 2004). Cross shows how expert designers have the capability to think in terms of the co-evolution of the solution and problem spaces, having the goal of finding matching problem-solution pairs (Dorst & Cross, 2001). Discussing the dynamics of the teamwork Cross distinguishes between three different types of processes: a technical process, a cognitive process and a social process, arguing for their acknowledgement and integration in the overall design thinking process (Cross & Clayburn Cross, 1995). The successful integration of these processes develops in time and as shown by Dorst and Lawson (2009) is part of the evolution of the designers from novice to expert. This underlines the importance of the design thinking in multidisciplinary team-work and the relevance of design thinking framework in other professions (Martin, 2009).

As a reaction to increasing migration of the design thinking concept into other disciplines, Kimbel seeks to re-establish the understanding of the design thinking in the perspective of design practice (Kimbel, 2009). Furthermore, Tonkinwise suggests that the design thinking paradigm grew into an autonomous concept, increasingly dislocated from the design practice by the means of downplaying the importance of aesthetics and style (Tonkinwise, 2011). He argues for the necessity of re-introducing the design practice as an intrinsic component of the design thinking as a way of preventing sterile interpretation of what essentially defines a design skill acquired through hands-on experience.

In the design education, the hands-on experience has always been the starting point for shaping the sensibility and craft of the young designers, nevertheless little attention is usually given to the organizational component of an essentially collaborative discipline such as design. Perhaps one of the most important tacit skills acquired in design schools is the versatility of thought and the capability to connect and investigate a variety of practices from other disciplines. In this perspective the young designers learn to create a relational system that supports their activities. In this sense, the ingredient that misses from the design education is the acknowledgement of one’s personal limits and the recognition and respect of other’s contribution to what essentially is a collaborative work.

2.2 From thinking to mind frame

We suggest that the change of paradigm in the undergraduate design education revolves always around the design practice but encompasses a wider trajectory that integrates the design leadership mind-set. In this sense we relate to Lucy Kimbel’s perspective on design thinking which presents design thinking,

… generated as a way of understanding what is distinctive about what designers do but viewing it as a social accomplishment in which bodies, minds, objects, agency, process, structure and knowledge are all implicated, and linking what designers do with what users do in their practices. (Kimbel, 2009).

This perspective introduces the relational level mentioned before and shifts the focus from the final outcome of the design activity – the design artefact, to the system of relationships that the designers have to envision and lead.

The design leadership mind frame – the capability of perceiving the overall system transforms isolated thinking into an expanded awareness of the self in relation to the organization and therefore the readiness to act as a guide for the overall organization. In this

sense the design expert thinking transforms into an expanded leadership mind frame in which the practical expertise reinforces the leadership capabilities. In this concern, previous literatures have shown how design leaders have to encompass several core responsibilities in order to engage and guide. As such, Muenjohn drafts a conceptual framework that underlines the following core responsibilities of the design leaders:

- envisioning the future
- manifesting strategic intent
- directing design investment
- creating and nurturing an environment of innovation

(Muenjohn, et al., 2013)

2.3 Design leadership in design education

The previous distinction between design thinking as a problem solving methodology and design leadership mind frame as a systemic understanding of the problem solving process, and its impact in the organizational context can be better understood when mapped on the skill levels and mental functions at the different levels of expertise (Fig.1).

SKILL LEVEL / MENTAL FUNCTION	NOVICE	COMPETENT	PROFICIENT	EXPERT	MASTER	VISIONARY
RECOLLECTION	non-situational	situational	situational	situational	situational	chance seeking
RECOGNITION	decomposed	decomposed	holistic	holistic	holistic	random
DECISION	analytical	analytical	analytical	intuitive	intuitive	instinctive
AWARENESS	monitoring	monitoring	monitoring	monitoring	absorbed	mutated
	Youth Training				Adult Education	

fig. 1 The expertise levels modified from (Dreyfus & Dreyfus, 1980) to include the 6th, visionary level.

Looking into detail at each category of mental functions and tasks helps envisioning the dimensions in which the coaching for mastery in design leadership can evolve.

With respect to the recollection of situations at the expert level in which "the expert has learned to distinguish those situations requiring one reaction from those demanding another" (Dreyfus, 2004, pg. 180), at the master level it is the observation of the situation at hand that provides the cues for orientation. In other words the master's mind-set is not projected solely on the past experiences but remains alert to the present and incoming stimuli. This enables him/her to recognize the specificity of the new circumstances in a holistic perspective and activate almost instantly the decision and action. The speed of reaction with which the master activates his/her perceptive resources coordinating them with the decision process requires an inward attention towards the emotional signals that guide intuitive action. This underlines the state of absorbed awareness concentrated on self-consciousness. Figure 1

shows how bringing the levels of expertise in the context of the design environment, the professional expert, that before was confined to his/her skills and ecosystem of the own studio, gains a strategic leadership role for an extended community of practice. In this context, coaching adaptive behaviour and an increased awareness, which mutates from individual skills to attain the visionary mind frame described above.

3 Introducing a leadership mind-set to undergraduate students.

As shown in the previous part, to achieve an expanded, visionary level it is necessary to project the design perception in a systemic perspective. In the next chapter we advance the hypothesis that young design students can benefit by being exposed to the possibility of envisioning their role in an organization at an early stage in their design education. This can give them a better grasp not only on the skills that they have to acquire in order to become design professionals but also on the different responsibilities that they should assume from the beginning of their professional career.

The observation on the different capabilities of the young students comes also from the senior teaching experience of the authors. Although all design schools ask students to fill in a survey regarding their aspirations after graduation, teachers are the first ones to sense the potentialities on their students, which go beyond the acquired skills. Moreover, while the young generation of designers is expected to challenge the norm and eventually change the out-dated practices, it is the role of the educators to prepare them for actually being able to do it.

In the following sections we will describe the results from an open answer survey which asked students the role of the designer in the society, the understanding of the concept of design revolution and the meaning of leadership in design. The questionnaire was intended to stir a discussion on themes not necessary related to the project brief and inquire the understanding of the concept of leadership in design.

3.1 “Design revolution” in conversation with future designers.

In his recent book “Beyond the infinity. The story of potentiality from sacred to technique”[2] Mauro Magatti wrote:

“During time, the process was pushed so far as to make the “what is made” more and more irrelevant (and even more why), to the whole advantage of the very act of being made (and with the prevalence of how). From this point of view, the efficiency is the fundamental criteria that legitimizes the technical potential: that what is efficient, or what is being made, overcoming the value of the reality proof, in the framework of the technical world that man himself built, is *powerful*.”(Magatti, 2018, p.170).

This paragraph synthetizes well the emphasis put on the process with respect to the meaning of the design artefacts. This is a trend we witness in particular in the product design, where the advances of digital technology drain the significance of the actual outcome. The questions asked to the students, which we will present below, were aimed at contextualizing the process of designing in a larger frame, in an attempt to induce a critical view on the purpose of expressing the creativity.

The questions was divided in 3 types:

[2] Original title in Italian: “Oltre l’infinito . Storia della potenza dal sacro alla tecnica”

1. **Questions regarding the relevance of the design discipline in the social context:**

a. In what ways can design contribute to world's most pressing issues?

b. How can design be part of the solution and not the problem?

2. **Questions concerning the meaning of "design revolution".**

a. What is a design revolution?

b. What is the difference between "trendy" and "revolutionary?

3. **Questions related to the role of the designer and the relevance of design leadership.**

a. Name a revolutionary designer.

b. A designer should be: 1. a skilled professional; 2. a creative artist; 3. a good manager; 4. a good leader. Indicate the order of importance.

The answers revealed several important aspects that shown in the **first category** of questions the assumption that design provides solutions to incoming environmental problems, the majority of students focused on how to "fix" the environmental issues by improving products and services, or presented the design discipline as a "tool". In the **second category**, the "design revolution" was mostly seen as referring to the way in which the design practice was changed by the incoming technological advances, somehow self-referenced and detached from the overall socio-historical context. Nevertheless the "revolution" was perceived as a long-term drastic change. In the **third category** the majority of students placed creativity as the most important characteristic of the good designer, while the leadership capabilities were not regarded as some of the most relevant.

3.2 Activating the awareness about the importance of teaching design leadership

Although the questionnaire presented above was just an attempt to test the understanding of the leadership in design it is important to stress out the necessity to improve the awareness about the social impact that design has in all the facets of everyday life. For this reason we argue that in order to activate the learning about leadership it is necessary to remember the importance of imagination in blending the hands-on skills with the knowledge and expertise of the design professionals. Rather than delineating designers' "place" it is more important to focus on the role of the design leaders and understand empowerment as an important responsibility. This process of empowerment is necessary in order to acknowledge the changing reality of the market place and prepare the new generation of designers to face its challenges. In this sense the actual task of the designers from a leadership perspective is to guide from within the organization with an experiential learning approach (Kolb & Kolb, 2005) (Kolb, 2014). The most important contribution of the design leaders it is to push the boundaries of the limited perspectives with the use of imagination, continuously enlarging the domain of vision, action and possible achievements.

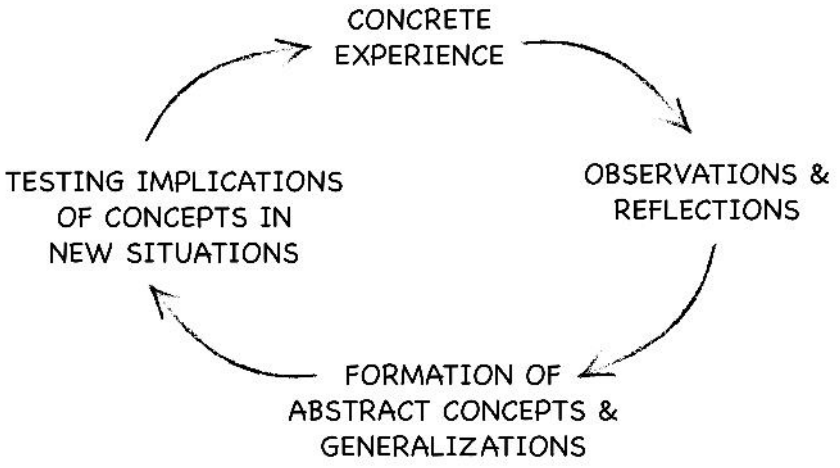

Fig.2 Experiential Learning Model (Kolb, 1976)

The ultimate goal is not to find solutions to incoming problems, but to revert the perspectives transforming the obstacles in opportunities for change, or introduce new problems with the objective to frame the context of change. We argue that, the experiential learning model (EL) proposed by Kolb (fig. 2) is a valid coaching methodology that can integrate design thinking and practice into the design leadership mind frame, in particular because its cyclical integration of concrete experience in the abstract conceptualization required by a strategic leadership. In this sense design "penetrates" into the everyday life, it also has the potential power to induce disruption " CHANGE " in a mainstream behaviour of unquestioned acceptance, favouring an attitude of readiness and openness towards the unknown.

3.2 Conclusion. Shifting from "efficient" to "dynamic" energy in design.
Rather then stressing the understanding of the "design revolution" in terms of a breakthrough, we suggested in this paper that the design education can benefit from shifting the focus on expressing creativity through efficient artefacts to teaching the young generation how to preserve resources and adopt a leadership attitude.

We argued that this type of "revolution" can have a deeper and longer term impact on the design education helping to adjust the expectations of the students to the reality of the continuously changing work environment. In this respect we conclude by stressing out how the "efficiency" contradicts "dynamic" or the possible change, for as Magatti explains,

"…being efficient ,means aligning oneself to a collective imaginary of potentiality subtended to the idea of growth: we are too many, the resources are limited and the demand infinite; nevertheless we are morally expected not only to efficiently use the resources but also to be efficient in order to avoid being a nuisance to the well functioning of the overall system." (Magatti, 2018, p.171)

The question remains if the new generation of designers will be able to challenge the efficiency and maintain the energy of the possible change?

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Local creative industries may be more global than we think: A study of tenants based at Baltic Creative, Liverpool

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LOCAL CREATIVE INDUSTRIES MAY BE MORE GLOBAL THAN WE THINK explores the extent of international trade amongst a group of UK-based, micro-enterprises and SMEs (small-and-medium sized enterprises) classed as "creative industries." The UK government's 2018 *Industrial Strategy: Creative Industries Sector Deal* aims to increase UK creative industry exports by 50 per cent within 5 years, arguing there is a "great deal of untapped potential in the sector." It also identifies small company size as a particular challenge to creative industry exports. The Department for Digital, Culture, Media and Sport (DCMS) maintains that in 2016 only 18 per cent of creative industries businesses engaged in international trade (DCMS, 2018a). Our research challenges these assumptions. At least one creative industries hub is already deeply entwined in global trade. In Liverpool's creative and digital hub Baltic Creative, 69 per cent of tenants export. Furthermore, these exporters are highly dependent on their overseas income. Over one-third of exporters earn more than 50 per cent of their annual income from exports. Our research also finds that company size had not acted a deterrent to international trade. Rather company owners report concerns about access to global markets after Brexit, which had already resulted in significant financial losses for some. Our study reveals that even the smallest micro-enterprises are exporting not by way of strained or concerted efforts, but simply because they are operating in an open, digital, global environment where international trade is integral to their business.

Keywords: creative industries, international trade, Brexit, uncertainty, exports, policy, Creative Industries Sector Deal

1 Introduction

Creative industries are growing at nearly twice the rate of the rest of the UK economy (DCMS, 2018b). In 2015, they account for 6 per cent of UK jobs and an impressive 9.4 per cent of the UK's total services exports (DCMS, 2017).

Nevertheless, policy-makers are concerned that the creative industries are not sufficiently engaged in global markets. The government's 2018 Creative Industries Sector Deal aims to increase exports by 50 per cent before 2023 because the sector still offers a lot of "untapped potential" with many firms not yet exporting (BEIS, 2018). The Department for Digital, Culture, Media and Sport (DCMS) maintains that only 18 per cent of creative industries businesses engage in international trade (DCMS, 2018a).

Creative firms are seen as having industry-specific barriers to international trade, in particular small company size (BEIS, 2018). The average creative company size is 3.3 full-time employees (FTE) and 34 per cent of creative sector workers are self-employed, which is more than double the UK average (Bazalgette, 2017). The Creative Industries Sector Deal states that micro-companies lack the "absorptive capacity" to undertake extra export duties such as identifying useful information and translating it to commercial ends (BEIS, 2018).

This paper calls many of those assertions into question. In at least one creative industry hub – Baltic Creative in Liverpool – even the smallest one-man-band is already deeply engaged in the global economy. Creative industry firms in this cluster are exporting at much higher rates and with more economic impact than government figures suggest. Contrary to reports such as Sir Peter Bazalgette's 2017 Independent Review of the Creative Industries and Frontier Economic's 2016 Absorptive Capacity: Boosting Productivity in the Creative Industries, small company size does not affect their ability to export.

Our research suggests that official statistics may be underestimating the true value of exports to the creative industries. On the one hand, the number of businesses exporting and the financial impact of these exports are cause for celebration. On the other hand, the existing extent of international trade may limit the ability of creative industries to further increase exports by another 50 per cent as the Creative Industries Sector Deal aims to do. Furthermore, undervaluing international trade takes too lightly the prospective negative effects of a significant break with the UK's existing and hitherto successful international trading system.

2 Methods

Our research was conducted at Liverpool's Baltic Creative Community Interest Company - a commercial property landlord providing space specifically designed for the creative industries. In May 2018, we asked company owners and freelancers, all based out of Baltic Creative, to complete an online questionnaire about their international trade. Our *International Trade Survey* consisted of 16 quantitative and qualitative questions. We sent the survey to 75 tenants of which 59 responded. Each question in the online survey left room for a supplementary, open-ended reply. Many respondents used this space to clarify their responses.

From June to October 2018, we also conducted almost a dozen semi-structured, personal interviews both in person at Baltic Creative and over Skype. The interviews included owners of companies that both trade internationally and those who do not. Some quotes mentioned in this paper are from the personal interviews and others are from the open-ended replies in the Export Survey.

In addition, we cross-referenced the our *International Trade Survey* with data from Baltic Creative's *2018 Business Owners Output Survey*. Here, each year Baltic Creative's tenants are asked to provide key figures including questions on annual turnover, number of employees, annual growth and expected growth. In 2018, 71 company owners responded to this survey. We used this data to arrive at figures such as median company size, annual turnover, and per-employee GVA of both exporters and non-exporters.

In summary, 43 company owners/freelancers responded to both surveys, 16 responded only to our *International Trade Survey*, and 30 only responded to Baltic Creative's annual *Business Owners Output Survey*. In total we have data from 89 companies and freelancers.

We took all available data to come up with the “average” Baltic Creative tenant, but since the sample size of 89 is relatively small, we have used “median” figures rather than “the mean”. A very small number of firms at Baltic Creative have turnovers well in excess of £1m and employ over 50 workers, which would significantly distort the mean of a small sample. By using the median we have arrived a more accurate snapshot of the “average” firm based at Baltic Creative.

While official DCMS statistics state that almost 18 per cent of creative industries firms traded internationally in 2016 (DCMS, 2018a), this study has found that 69 per cent of Baltic Creative tenants export. Of the 30 per cent who do not trade internationally, one-third would like to start exporting in the near future, as shown in figure 1.

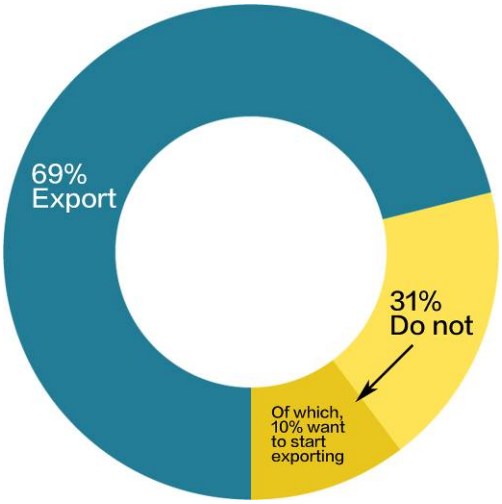

Figure 1. Proportion of Baltic Creative tenants that export. Source: CM Patha.

Isolating the exporting firms from the whole of Baltic Creative, henceforth “exporters,” we found that most trade in services with 70 per cent trading only in services, 15 per cent trading in both goods and services, and another 15 per cent trading in goods only, as demonstrated in figure 2.

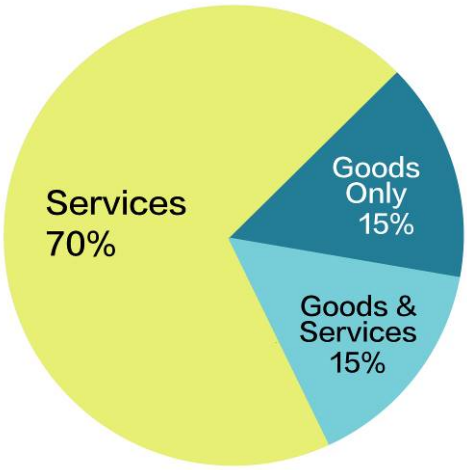

Figure 2. What Baltic Creative “exporters” export. Source: CM Patha.

Baltic Creative’s exporters make a significant share of their income from overseas, as shown in figure 3; 35 per cent of firms make over 50 per cent of their total income abroad, 37 per

cent make between 10 and 50 per cent of their total income abroad, and 29 per cent make under 10 per cent of their total income abroad.[1]

Figure 3. Baltic Creative's "exporters" rely heavily on their international income. Source: CM Patha.

Exporting is only half of the story. Baltic Creative exporters also import goods and services from abroad. Only one firm imported a small amount without exporting. Some exporters did not import, but most did, as demonstrated in figure 4. While 21 per cent spent of exporters spent no money abroad, 38 per cent spent up to 10 per cent of their total expenditure abroad, 22 per cent spent between 10 and 25 per cent abroad, and 19 per cent spent a significant 25 per cent or more of their expenditure abroad.

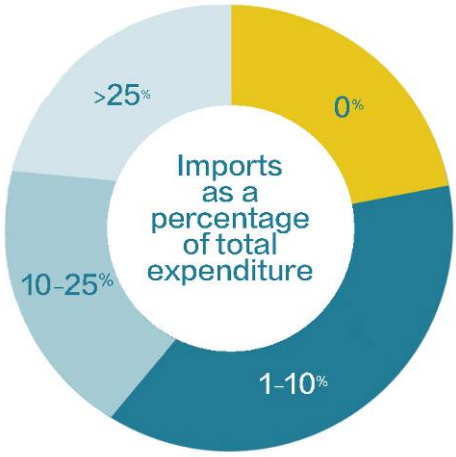

Figure 4. Percentage of total expenditure made abroad ("imports"). Source: CM Patha.

Both exporters and non-exporters perceived the same major barriers to international trade, as shown in figure 5. The main concerns are finding clients and building relationships, access to knowledge and skills related to international trade, language and cultural issues, and the cost of doing business abroad. Interestingly, one would expect seasoned exporters

[1] Detailed foreign income breakdown: 15 per cent of exporters earn over 75 per cent of their income from abroad; 20 per cent earn between 50 and 75 per cent of their income abroad; 15 per cent of exporters earn between 25 to 50 per cent of their income from abroad; 22 per cent earn between 10 to 25 per cent of their income abroad, and 29 per cent earn under 10 per cent of their income abroad.

to be less anxious, but exporters in fact are more worried about customs procedures, delivery, tariffs and duties than non-exporters.

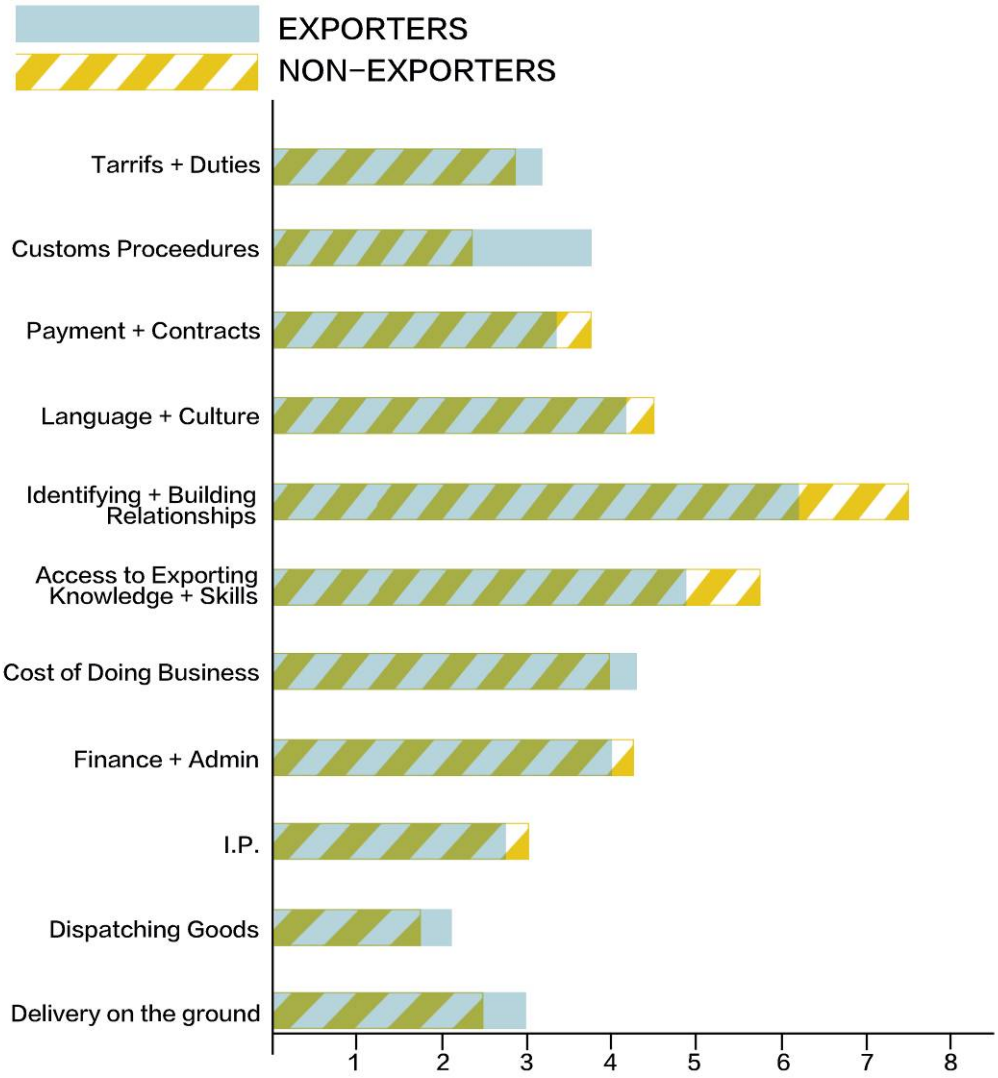

Figure 5. Perceived international trade barriers. Source: CM Patha.

During our interviews, tenants often voiced a concern about the UK's referendum resolution to leave the European Union (EU), so-called Brexit. The EU is a key export destination with 90 per cent of exporters at Baltic Creative trading with the EU, 63 per cent trading with North America, and 51 per cent trading with Asia. Of all the companies we surveyed and interviewed, only one had managed to profit from Brexit: "So far, Brexit has been good to us because the pound has weakened to the dollar and 65% of our income is in US dollars. We've consciously spent aggressively to acquire more US customers while the pound is weaker." The rest of the companies were either apprehensive about the effect of Brexit on their future business or had already faced significant losses since the June 2016 Brexit referendum. One SME owner admitted, "We are retrenching all international business and making teams redundant to increase productivity. Because of Brexit, we've lost 7 major contracts in the last 12 months, a risk we cannot afford to make again."

Baltic Creative houses a selection of freelancers, micro-enterprises employing fewer than 10 people, and a small number of companies employing between 10 and 50 people. Only one company in 2018 employed more than 50 people. The median company size at Baltic

Creative in 2018 was 2.5 fulltime employees (FTE). The median company turnover was £127,000. The median turnover per employee was £50,500.

3 Discussion

3.1 Company size and intra-hub analysis

A year after the Brexit referendum, in which UK voters decided to leave the European Union, the UK government launched its 2017 Industrial Strategy. Intending to bolster Britain's global leadership in industries of the future, the Industrial Strategy announced "Sector Deals" between the government and selected high-impact, high-potential industries. The aim of the sector deals is to increase productivity through government investment, thereby cementing the UK's position as global leader in the selected industries. In 2018, the government rolled out the Creative Industries Sector Deal, prioritising the "scaling-up" of creative companies in order to raise productivity and increase exports (BEIS, 2018).

The Creative Industries Sector Deal borrows heavily from the 2016 Frontier Economics report Absorptive Capacity: Boosting Productivity in the Creative Industries. The report contends that the prevalence of micro-enterprises (firms employing fewer than 10 people) is hampering the creative industries because they are "less productive, innovative, and growth-oriented than are larger businesses" (Frontier Economics, 2016). This is because micro-enterprises lack "absorptive capacity," which is the ability to identify and assimilate relevant new ideas, use them to transform internal practices, and finally, generate higher returns (Frontier Economics, 2016). The report's solution to increasing productivity in creative industries, then, is to help firms grow, or "scale-up."

With 95 per cent of creative industry firms employing fewer than ten people, the Creative Industries Sector Deal identifies company size as a particular challenge for engaging in international trade. It argues that micro-companies lack the "absorptive capacity" to undertake "extra" export duties (BEIS, 2018). Sir Peter Bazalgette's Review of the Creative Industries also points to this Achilles Heal: "Many would-be creative clusters face issues linked to business size. They lack modern leadership, commercial confidence and acumen to realise their growth potential so that they can take on more lucrative ventures, including exports." (Bazalgette, 2017). Even contemporary trade theory concurs stating that, "exporting firms are larger, employ more workers, use more capital, pay higher wages, use more skilled workers, and are more productive"(Marrewijk, 2017).

This could be a cause of concern for the UK's creative industries where 35 per cent of workers are self-employed compared to an average of 14 per cent across all industries (DCMS, 2017). The average UK creative company size is the equivalent of 3.3 FTE and shrinking (Bazalgette, 2017). In fact, creative industries firms in 2007 were 15 per cent larger than in 2014 (Bazalgette, 2017). If smaller companies have a harder time exporting, the creative industries are indeed headed for trouble.

Luckily this is not what our research finds. The mean company size of exporters at Baltic Creative is 3.2 FTE, in line with the national creative industries average of 3.3 FTE. Of the 20 freelancers at Baltic Creative who responded to the 2018 Annual Business Owners Survey, eight responded to our International survey. Of those eight freelancers, six export. Five of the six exporters make more than 50 per cent of their income through exports. Their median annual income is £70,000.

We must insert a caveat here. The freelancers and companies based at Baltic Creative are a self-selecting sample. Baltic Creative is not a charity, nor does it offer young companies "seed funding" like an accelerator or incubator might. All of the tenants at Baltic Creative are paying market rates for rent. It's possible, therefore, that these tenants are more successful than their average creative industry colleagues. They can afford to pay rent rather than working from cafés. Then again, working in a creative hub may, in-turn, make them more productive and economically viable.

Consequently, it's important to undertake an intra-hub analysis, measuring Baltic Creative tenants against each other to see if any of the rules of international trade theory apply. Are these exporting firms "larger, [do they] employ more workers, use more capital, pay higher wages, use more skilled workers, and are more productive"? (Marrewijk, 2017).

On the three measures we can calculate, exporters at Baltic Creative do in fact employ more workers, have higher turnover, and have higher per-worker turnover than the average company at Baltic Creative.

If we look at all the companies at Baltic Creative, the median number of employees in 2016-2017 was 2.5 FTE with a projected 3.5 FTE in the following financial year. Meanwhile, exporters at Baltic Creative had a higher median employment rate of 3.2 FTE, expected to rise to 4.5 FTE in the coming financial year.

The median company turnover of all firms in 2016-2017 was £127,000, projected to increase to £180,000 in the next financial year. Exporters median turnover was significantly higher at £200,000 in, expected to rise to £240,000 in the following financial year.

In terms of productivity, exporters at Baltic Creative in 2016-2017 had a higher turnover per employee at £60,000 as compared to the median turnover per employee of £50,500.

So comparing all the tenants within Baltic Creative to each other, the exporters do indeed exhibit traits predicted by international trade theory: they employ more workers, have higher turnover, and have higher per-worker GVA than the average Baltic Creative company.

These findings, however, show that small company size per se is not a barrier to international trade. Whether exporting or not, the median Baltic Creative company is still a micro-company employing between 0-9 workers. The Creative Industries Sector Deal is concerned about micro-companies since they account for 95 percent of creative industries firms (BEIS, 2018). That sounds like a rather shocking figure. In fact, it is completely in line with the UK average – 96 per cent of all UK companies are micro-businesses (Rhodes, 12 December 2018).[2]

Our study finds many more micro-companies conducting international trade – and with more economic significance – than official statistics indicate. While official figures point to only 18 per cent of creative industries trading internationally (DCMS, 2018a), our study finds that 69 per cent of Baltic Creative tenants trade internationally. Their trade is also economically significant with over 70 per cent of Baltic Creative exporters making more than 10 per cent of their annual income from exports.

[2] The UK government produces conflicting figures. The DCMS report *Sectors Economic Estimates 2016: Business Demographics* states that 89.2 per cent of UK businesses in 2016 employed fewer than 10 people. It's unlikely that the number jumped from 89.2 in 2016 to 96 per cent in 2018.

How can our figures differ so significantly from official reports? No standard deviation can account for the gross disparity between our figures and those presented by the DCMS. Why are Baltic Creative tenants exporting at much higher levels than conventional theory or statistics would expect? Are Baltic Creative tenants exceptionally good at international trade? Are they engaged in more international trade than other random samples around the country? Several factors offer an explanation for the difference.

3.2 Clustering and Scaling-up (without Hiring More Employees)

Our entire survey sample is located at Baltic Creative, a creative industries hub. These are not atomized freelancers and companies working from their kitchen tables. Baltic Creative occasionally hosts events to foster interaction and a sense of community amongst tenants. It regularly offers free business advice seminars to tenants, on-site and at convenient times. The management at Baltic Creative is on a first-name basis with almost all tenants. Micro-enterprises are well positioned in such an environment to "punch above their weight." They have access to other experts within their own business environment, which they can hire on a needs-be basis rather than employing full-time staff. Indeed, Baltic Creative's Annual Business Owner's 2016-2017 survey has found that 72 per cent of tenants collaborated in some form.

Clusters have long been viewed as a driving force for businesses growth (Porter, 1990). A key ingredient to the growth is "knowledge spillover" created when industries are located in a geographically dense area. Michael Porter argues that similar industries compete locally, which drives innovation. Only the strongest firms and innovators survive this competition, thereby driving a globally competitive hub such as Silicon Valley (Porter, 1998). Others argue that clusters work mainly by drawing a pool of researchers, company founders and talented potential employees into a particular geographical region such as the Cambridge IT cluster (Huber, 2012). In some cases, employees may physically "spillover" information and innovation from one company to the next by switching jobs, as in the high-profile case of a key engineer moving from Google's self-driving car unit to Uber – resulting in a lawsuit about the theft of trade secrets. Whatever the mechanism, many economists point to clusters of specific or multiple industries as a driver of innovation and growth.

While the Internet has provided access to global specialists all over the world, clusters still have their advantages. One Baltic Creative company owner and exporter told us,

> *"I recently hired a Google ads expert. I looked all over the Web to find somebody and there's plenty of companies or agencies that will do it. The problem with agencies and companies is that you don't get good value for your money. It's so much better if you can find an individual to work with… In the end, I found a Google ads expert at Base Camp [a co-working space within Baltic Creative]. He is a real specialist and he sits next door. When you're in this online business everything is done by e-mail and it is a refreshing change to speak to somebody and express what you need in person instead of doing it backwards and forwards through e-mail…The first thing I do now is look to Base Camp."*

This company employs only 4 people, but earns between 50 and 75 per cent of its total income from exports. Rather than hiring a full-time employee to do the job, this micro-enterprise hired a neighbouring freelancer to increase exports.

In terms of exporting, however, none of the interviewed firms increased their exports directly via the assistance or insight of their neighbours at Baltic Creative. One micro-enterprise

owner, nonetheless, saw spillover benefits from locating at Baltic Creative: ”We co-habit [our office] with another company, and they asked, “Why don’t you claim for R&D tax credits? We do.” The micro-enterprise owner had been unaware of the UK’s Research & Development Tax Credit scheme. His unplanned, serendipitous conversation ended up saving his company thousands of pounds. Serendipity is an important benefit of clustering and it’s countless opportunities for face-to-face contact (Storper and Venables, 2004).

Interestingly, these two examples of increased productivity resulted – not from scaling-up – but rather from clustering micro-enterprises into one shared location. No interviewees saw a direct positive impact of clustering on their exports, but the benefits of clustering at Baltic Creative may be increasing their productivity, which if the theory is correct, may be expanding their ability to export. Clustering micro-enterprises may be a more economically viable and efficient way of helping them “scale-up” – by expanding the network and knowledge base - without actually having to increase employee numbers.

Scaling up does not always have advantages. At least one company owner cited worries about increased risks with scaling-up. Hiring more full-time staff required certainty of increased turnover. In an era of instability marked by Brexit, this micro-enterprise owner was unwilling presently to take that risk and preferred to hire freelancers on a case-by-case basis. While some economists point to the failure of many attempts at active clustering – for example, where business parks are set up, but no interaction between tenants results (Wadha, 14 July 2011) – clustering may be a key to the success and sustainability of the micro-businesses and freelancers that increasingly characterise the creative industries. Businesses employing more than 10 people may indeed not require the serendipity and peer support that clusters offer because, as they grow, they hire specialised staff members and develop their own internal logic. But micro-enterprises and freelancers may benefit from the spillover effects and peer support that clusters such as Baltic Creative offer.

Clustering, however, is not enough. Innovation may spring from the serendipitous chance encounters afforded by clustering or it may result from active, intentional planning by company managers (Fitjar and Rodríguez-Pose, 2017). In today’s globally interconnected world, face-to-face encounters may spurn some innovation, but international encounters are crucial to the process. A large-scale study in Norway reveals that companies maintaining ties only with players in the same cluster or region are four times less likely to innovate than companies that are globally connected (Fitjar and Rodríguez-Pose, 2011). Silicon Valley is also a globally connected cluster where international information sharing and risk-taking are cultural and entrepreneurial norms. (Wadha, 14 July 2011). It’s important to view the export success of Baltic Creative tenants not only in the context of their cluster, but also the internationally connected environment in which they operate.

3.3 Business as Usual: International Trade in the Digital Economy

The Creative Industries Sector Deal, the Frontier Economics and Sir Peter Bazalgette reports all contend that the micro-enterprises lack the “absorptive” capacity to increase exports. These reports, however, do not look deeply enough at the digital economy, which has – in less than two decades – dramatically reduced trade barriers for both large and small creative industries firms.

For an increasing number of creative industries firms, international business is not extra business: it’s just business. One micro-enterprise owner told us, “We never set out to export. It's just the nature of the Internet to unlock that kind of potential without thinking you're

starting a global business." This business creates YouTube content and over 75 per cent of its income is earned through overseas viewers and the associated advertising sales. The owner started the YouTube channel as a side project and now the firm employs 4 staff and 15 freelancers. "YouTube is a global platform. The videos took-off and then last year, I focused on it full time. Now it is my full-time [job]."

This business is part of a growing trend. YouTube is already one of the UK's biggest content exporters according to The True Value of Creative Industries Digital Exports, a major joint report by the Centre for Economics and Business Research (Cebr), the Creative Industries Council and the Creative Industries Federation. The vast majority of all videos uploaded in the UK – 78 per cent – are watched by viewers in foreign countries (Cebr et al., 2018). The report argues that official figures are likely not capturing many cross-border transactions, particularly underestimating creative digital services. A creative digital service – such as a tutorial on YouTube from a crafts company on how to make a ceramic bowl – "may not be registered as a service export…due to difficulties capturing data for business models such as those offering free content and based on advertising revenue" (Cebr et al., 2018). Even in the case of saleable digital products, such as apps, it may be difficult for digital intermediaries to track down the origin of sale or purchase (Cebr et al., 2018). Using a combination of official DCMS government figures, interviews and survey results, the report determines that that creative industries export £46bn in goods and services – 24 per cent higher than the official figure. They put this discrepancy down to the underestimation of digital services in the creative industries by a whopping 40 per cent. The report argues that, "We live in an era where the methods we currently use to trace trade flows are losing their relevance and ability to depict an accurate picture of trading realities" (Cebr et al., 2018).

The current methods for measuring trade are becoming obsolete because the digital environment is rapidly and spectacularly transforming the way we do business. "In 2005, or whenever it was, Google came up with this thing called Adsense. Overnight [my website] went from just [sitting on] the Internet somewhere to making more money than I made working full-time in the NHS." Sensing the growing potential of the Internet, this Baltic Creative tenant left his job, and with a partner, started a home-study company in 2008. Using a website as their marketing tool, their company sold DVDs. "We started off essentially as an exporter," he said. "We chose to price in dollars very early on because it's [the main] currency in the world. People in the UK are more comfortable paying US dollars than people in the US… paying in British Pounds." When the UK post-office privatized in 2013, postal prices increased so the firm decided to stop selling physical DVDs, restricting sales to online streaming only. The move to a purely digital online service increased international sales. His company makes approximately 70 per cent of its annual income from exports and spends between 25 to 50 percent of its expenditure abroad (imports). In 10 short years, the Internet transformed this micro-entrepreneur's career and business. The owner concluded, "If you are an online business and you are selling digital products, I think it's fairly standard that you are more of an exporter than…a domestic company because the cost of delivery is not there and the cost of fulfilment doesn't exist. So it makes sense to open your borders from day one."

It's not only digital creative services that benefit from this borderless global trade. Goods also have witnessed dramatic reductions in barriers to trade. In fact, the UK has unique and significant advantages over other exporting nations – its national language is the lingua franca of international business and its cultural outputs are readily accepted by consumers in

foreign countries. “When we launch a product, we press release it [around the world]” another micro-enterprise owner told us. “As a result, it gets picked up by press and blogs in the US, UK and Europe. Our products are about film, music or literature…popular culture…that's why our customer base is so international. This micro-enterprise is mainly consumer-facing with 95 per cent of sales direct to the customer. Between 50 and 75 per cent of income is from foreign sales. So far this firm has not translated its website into foreign languages nor has it priced goods in foreign currencies, although it is currently looking to do so. UK businesses may increase their sales by setting up websites in US Dollars or Euros, but the case study above proves that only one English-language website where products are charged in GBP can still result in significant foreign sales. This would not be possible for Polish, Lithuanian or German creative industries firms where at least translating websites or products into English is a basic, necessary extra delay and cost to exporting.

3.4 Small Data?

These examples, however, still do not answer the fundamental question: Why do the export figures in our study differ so spectacularly from those mentioned in DCMS statements, the Creative Industries Sector Deal and the Bazalgette and Frontier Economics reports? These reports all rely heavily on the reliable figures provided by the Office for National Statistics (ONS). What if some of these reliable statistics are…unreliable?

As some economists argue, we are facing significant gap in our understanding of how exports and common statistics like GDP work (Coyle, 2015). On the one hand, we have more “big data” than ever before. On the other hand digitisation means many economic indicators simply are not getting factored into national statistics (Coyle, 2015).

One might expect the ONS to employ cutting-edge digital strategies and to exploit data from other government departments such as HMRC and to arrive at its statistics. In fact, the ONS arrives at creative industries trade figures in the exactly same manner as our study – via surveys. For example, every quarter, the ONS requests 2,200 businesses to fill in the Quarterly Survey of International Trade in Services (ITIS). ITIS data “are based solely on survey data” (ONS, 2019c). The businesses that receive the survey are legally obliged to complete it. The ONS selects firms that employ more than 100 people because their business is so significant to their specific industry. It also selects “some small and medium businesses,” rotating them from time to time, noting that their view is important because their trading patterns are often very different to large businesses (ONS, 2019b).

The ITIS survey monitors 52 different types of services by country of origin and destination. That means that if all things are equal, roughly 42 businesses in each type of service are monitored. Service types include business services, financial services, research and development services, insurance, medical services, agricultural and mining services, legal services, and many other areas that do not fall into our field of study. We can assume that only a small segment of the companies surveyed actually fall into the creative industries sector. Given that the ONS admits most of the businesses surveyed employ over 100 people, it is likely that ITIS figures are overrepresented by larger companies and do not accurately reflect the experience of the micro-companies and freelancers that largely characterise the creative industries.

The government is not blind to this fact. In an effort to modernise statistics, it commissioned a report by Professor Sir Charles Bean of the London School of Economics. The 2016

Independent Review of UK Economic Statistics, also known as the "Bean report" contends that the ONS methodology of heavily relying on regular surveys as the source of economic statistics is "expensive and outdated" (Bean, 2016). Furthermore, the methodologies are not accurately reflecting the UK's true economic landscape. "Because large companies make up the bulk of economic activity, a comparatively small number of responses can produce headline figures," he argues (Bean, 2016). The ONS' Annual Business Survey is a particular cause of concern: "the sample is only made up of a small proportion of businesses means that it lacks sufficient granularity if the sample needs to be stratified finely by size, industry or region" (Bean, 2016). Given the use of big data to monitor everything from consumer preferences to physical movements via mobile phones, it's surprising that more technologically advanced approaches are not currently used by the ONS or that anonymised data are not shared across government departments. The Bean report contends that, "relatively little use is made of administrative data, such as that held by Her Majesty's Revenue and Customs (HMRC) and still less of other (and growing) sources of big data." In 2017, the ONS launched a Data Science Campus in an effort to modernise its methodology by applying innovative techniques from the field of data science. One can expect more robust statistics to emerge in the coming years.

3.5 Caveats of our Study: Firm Heterogeneity

A limiting factor of our research is that it is based on a small, geographically isolated sample of companies based in one location. Our study cannot claim to represent a broader snapshot of creative industries in the UK. Indeed, economics research has found that the differences between individual firms are so astoundingly large, so-called "firm heterogeneity," that they call into question the viability of generalising from case studies at all (Marrewijk, 2017).

That said, while Baltic Creative is certainly as heterogeneous as any other industry hub, it is by no means an outlier. It operates within a creative industries cluster that is neither a super-performer nor an under-achiever. For example, the government's Creative Industries Sector Deal identifies Liverpool as a cluster of high growth, but not high concentration (BEIS, 2018). Also, Liverpool's digital tech GVA in 2017 was smaller than almost any other one of the 30 digital clusters identified by TechNation (£456k)[3] and turnover by employee was far below any other digital cluster in the report (only £76,000)[4] (Tech Nation, 2018). Still, digital companies seem to do well in the relatively small digital cluster of Liverpool. TechNation ranks the North's Top 100 Fastest Growing Tech Companies and in 2018, 4 are based in Liverpool, placing Liverpool as one of the top digital destinations just behind Manchester (30 firms), Leeds (13 firms), and Newcastle (6 firms) (TechNation, 2018). The tech sector bears mentioning here because, while it is only one of nine sectors that make up the creative industries, it is by far the largest sector in terms of GVA.5 The companies based at Baltic Creative provide a better snapshot of ordinary creative firms than those based in other, higher-or lower-performing clusters.

[3] GVAs of digital industry clusters in Northern UK in order of size: Manchester £3.4b, Leeds £1.3b, Newcastle £1.3b, Leicester £895m GVA, Liverpool £456m, Dundee £205m (Tech Nation, 2018a)

[4] Turnover per employee in a sample of UK digital industry clusters: London £201k, Hull £133k, Sheffield £120k, Dundee £115k, Leeds and Leicester £113k each, Manchester £105k, Glasgow, Liverpool £76,000. (Tech Nation, 2018a)

[5] IT, Software and Games is the largest sub-sector in the creative industries at £34,704m GVA, more than double the second largest sub-sector Film & TV at 15,361m GVA (CISD, 2018).

Nonetheless, it will be critical to expand our research beyond one location to see if the export experience of tenants at Baltic Creative holds true for other freelancers and businesses or even other creative industry clusters. We are indeed undertaking further research with other creative industries hubs. Moreover, we will revisit Baltic Creative in 2019 and 2020 to assess the impact of Brexit on tenants' international trade.

4 Conclusion

What is key to the export success of creative industries, then, is not company size or scaling-up, as the Creative Industries Sector Deal suggests. Our study reveals that even the smallest micro-enterprises at Baltic Creative in Liverpool already export and that they are highly dependent on their exports for their total turnover. Indirectly, clustering at Baltic Creative may increase our cohort's productivity and this may in turn partly account for their export success. Another important factor in their export success is the global, open, digital economy where international trade is integral to their business. Increasing exports in the creative industries, then, requires seamless – or at least consistent – access to global markets and this is the greatest challenge that our cohort faces in the uncertain era of Brexit. Our findings are important because if creative industries are as financially reliant on exports as this study suggests, major disruptions to their international trading environment are potentially far more wide-ranging on this set of businesses than official reports might indicate.

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Participatory Design Competition Practice

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An increasing number of companies are trialing various external design resources to meet innovation needs, but assessing innovation in a design competition is difficult for enterprises. By studying the Thermaltake Creative Design Competition for 8 years, combining a literature review, empirical research, and interviews, the authors of this paper explore how to use design competitions as an effective resource for innovative concept exploration. The findings indicate that a company which used the participatory design methodology to manage design competitions needs to have sufficient R&D ability to assist the organisers and contestants in executing their objectives. The subject of the competition should be defined and transferred clearly to the contestants, and should be consistent with the company's innovation strategy. A design seminar is a helpful co-design process which allows the organiser and participants to work on the design together. The mutual benefit is important in participatory design competitions. This study can be a reference for enterprises wanting to use design competitions as an effective innovation design method.

Keywords: Design competition; Design resource; Participatory Design; Design management

1 Introduction

There are many practical cases of companies holding creative design competitions as a research platform for product innovation. The growing popularity of design competitions suggests that they are a firmly established innovation strategy (Lampel, Jha, & Bhalla, 2012). There are various purposes for companies to organise design competitions, as well as different structures and governance practices. For example, most sponsors do not participate in the contestants' entire design process, but some enterprises take an active part in some phases to transfer and provide information and assistance, such as subject introduction, technical seminars, and assessment meetings.

This paper is based on participatory design theories and the study of the Creative Design Competition sponsored by the Thermaltake Technology Co. Ltd (hereafter Tt Competition and Tt Company), a serialised competition which has been held for 8 years. It is a positive case to study how to use design competitions as a platform for innovation design to achieve creative results. Through an analysis of their results and experiences of holding design competitions, we can determine effective applications of competition architecture and governance methods, and expand the current research of design competition management to the event evaluation phase.

1.1 Thermaltake Company Product Innovation

The subject of this case study is Thermaltake and its creative design competition. Tt Company has the capability and experience of innovation research and development. Its Creative Design Centre is in charge of industry design. The Tt Company also takes an active part in cooperating with external design resources on new product design concepts and development projects. Due to the wide range of products, and in order to maintain its market competitiveness, the company promotes continuous innovative product development, which needs to be nourished with a steady stream of innovative product ideas and concepts. The company is continuously seeking new product concepts from external design resources to accelerate its innovation development and demonstrate its positive image of innovation.

1.2 Purpose of Design Competition

As a design method, a design competition is a type of “search” strategy (Banerjee & Loukaitou, 1990). With demands on product innovation concepts, some companies use design competitions to convey their innovation values, such as The James Dyson Award, while others explore potential new product ideas in design competitions and transfer winning entries into commercial products, such as Japan’s KOKUYO Design Award. Füller, Hutter, and Faullant (2011) introduced the “virtual design competition” as a new means of opening up the innovation process and enriching companies, and Lampel, Jha, and Bhalla (2012) have explored the competition phenomenon according to the development of open innovation, showing the relationship between innovation agendas and design competitions.

1.3 Participatory Design

In the design methodology described by Hanington and Martin (2012), participatory design is a complete design process involving exploration, derivation, and evaluation. Participatory design is a human-centred design approach based on collaborative design activities. Participants include designers, users, and non-designer professionals associated with design projects. Participatory design is a design method and concept. Spinuzzi (2005) proposes three basic stages in participatory design: (1) Initial exploration of work, the stage in which designers and users get to know each other; (2) Discovery processes, the stage in which designers and participants constantly exchange design ideas, stimulate each other, and identify needs and expectations; and (3) Prototyping, which provides a basis for designers and participants to repeat, joint, and explore further.

1.4 Assessment of Design Competitions

Chen (2004) divided design conception evaluation decisions into two stages: conception scanning and conception rating. Scanning is a quick and concise assessment of some feasible applications. Rating is a more careful analysis of these shortlisted ideas to choose the most successful design solution. Banerjee (1990) stated that the composition of the jury of a design competition should be diverse rather than uniform. Each jury member has his own perspective on design criticism. Therefore, the design juries should consist of multidisciplinary and unpredictable perspectives, not one “line of thought”.

2 Research Methods

The research methods for this study are divided into two phases. The first phase, a case study, includes data collection and analysis of the Tt Competition. The second phase is the expert and participant interviews, with the relevant personnel and entrants involved in the Tt Competition.

2.1 Tt Competition Data Collection

The data collection section includes the background of Tt Company and materials from the first to the eighth Tt Competition, covering the competition introduction, objectives, theme setting, entry assessment, and competition results. The collected data were then analysed to understand the company business strategy and how the Tt Competition is executed, as well as the results of the competition. Data collection items and content refer to the following table.

Table 1 Data Collection Items and Content.

Item	Competition related
Competition objectives	1.Competition introduction 2.Competition governance methods explanation
Subject setting	1.Competition subject setting process 2.Competition subjects
Entry assessment	1.Competition judging process 2.Jury setup 3.Judging criteria 4.Quantity of competition entries
Competition outcomes	1.Creative concept application 2.Design proposal commercialisation

2.2 Interviews and Discussion

The second phase of the study comprises interviews with sponsor personnel and participants from universities. The interviews were conducted in a “semi-structured interview”. The goal of the interviews was to collect the organisers and entrants’ feedback and evaluate the competition. Interviewees are listed in Table 2.

Table 2 : Interviewees and their Positions.

Department	Position
Board of Directors	CEO
Project Team	Project Director
Creative Design Centre	Design Manager
Creative Design Centre	Senior Designer
Business Department	Marketing Manager
Business Department	Product Manager
Lunghwa University of Science and Technology	Winner from the entrants
Datong University	Winner from the entrants
Taiwan University of Science and Technology	Winner from the entrants

The interviews were accompanied by a questionnaire, including closed- and open-ended questions to state personal opinions. The content of the questionnaire is listed in Tables 3 and 4.

Table 3 : Questionnaire of Expert Interviews.

Questionnaire of expert interview		
A. Performance of design competition		
A-1	What are the objectives of the competition?	Public benefit
		Brand promotion
		User comprehension
		New concepts
		Other
A-2	Have the objectives been achieved?	Public benefit
		Brand promotion
		User comprehension
		New concepts
		Other
A-3	What is your advice on how to improve the performance?	
B. Participatory design competition		
B-1	What are the purposes of applying the participatory design method in the competitions?	In line with the company's innovation strategy
		Increase feasibility of the proposal(s)
		Transfer user experience
		Increase participants' willingness
		Other
B-2	The achievments of the objectives?	In line with the company's innovation strategy
		Increase feasibility of the proposal(s)
		Transfer user experience
		Increase participants' willingness
		Other
B-5	Do you have advice for the process of participatory design competition?	
C. Competition assessment		
C-1	The appropriateness of the competition judging process.	
C-2	The appropriateness of the jury setup.	
C-3	The judging criteria.	Design concept
		Product market
		Feasibility
		Other
C-4	Do the winners meet the expectations?	
C-5	What is your suggestion for the assessment?	

Table 4 : Questionnaire of Entrant Interviews.

1. Design subject of the competition		
1.1	The channels to understand the design subject	□ Presentation by organiser
		□ Information collection
		□ Using experience
		□ Case study
		□ Other
1.2	Help from the subject instruction event	□ Subject definition
		□ User information
		□ Design specifications
		□ Market information
		□ Other
1.3	Suggestions for the competition preparation phase.	
2. Enterprise participation in design competition		
2.1	Design methods	□ Joint idea
		□ Brainstorming
		□ Product imagery
		□ Scenario-oriented
		□ Other
2.2	Assistance from the enterprise to design concept	□ Proposal discussion
		□ Workshop
		□ Case study
		□ User experience
		□ Other
2.3	Assistance from the seminar	□ Industrial design
		□ Engineering design
		□ Market positioning
		□ User experience
		□ Other
2.4	Suggestions to the organisers for the design concept phase.	
3. Design competition results		
3.1	The benefit of design competition participation	□ Practice
		□ Winner record
		□ Market information
		□ Using experience
		□ Other
3.2	The reasons to participate in the design competition	□ Competition reward
		□ Competition subject
		□ Competition organising
		□ Course arrangement
		□ Other
3.3	Suggestions on how to improve the design competition	

3 Tt Competition Data Analysis

3.1 Thermaltake Creative Design Competition Introduction

The initial purpose to hold the competition was for both public benefit and to enhance the company's brand image. The company also hoped to increase communication between industry and academia. As a public benefit of the design competition, the company provided design students with a platform to demonstrate their creativity and help them to understand industry practice through these competition activities.

3.2 Participatory Design in the Tt Competition

The participatory design of the Tt Competition includes three stages: subject introduction, entry assessment, and technical seminars.

Subject Introduction: At the start of the competition, the organiser holds a presentation of the competition subject in each participating university. The presenters include the design supervisor, project manager and users.

Entry Assessment: The Tt Competition judging process includes two stages: preliminary assessment and final assessment. The jury set-up for the preliminary assessment includes the company's internal professionals, such as the design manager, senior product designers, product manager, and R&D engineers, who are committed according to their professional backgrounds and positions within the company.

Technical Seminars: After the preliminary assessment, Tt Company arranges for all the shortlisted winners to visit its headquarters and participate in the technical seminars, in which Tt senior designers and engineers communicate with the participants and provide suggestions on improving their entries.

In the final assessment phase, the objects to be judged are the prototypes of the entries. The jury set-up for the final assessment combines internal and external experts. Before the final judging, the organiser explains the value setting of the competition and the judging criteria to the jury. The final judging is conducted through participants' presentations and work demonstrations. The final statistical average scores of the jury decide the winners.

3.3 Winners of the Competition

Since the first Tt Competition, the company has launched two products which were developed from the concepts of the winners. If an entry is selected to be commercialised, its entrant will be invited as an intern to participate in the whole process of the design development and the commercialisation work. In order to respect the rights of the inventors, participants whose works are selected for commoditisation will be awarded a prize.

4 Interview Data Analysis

4.1 Competition Subjects

In regard to the subjects of the competition, the expert interview data suggest that the subjects should be the product category in which the company is successful, and the subjects should meet market demands. They believe that, with narrowly-focused subjects, the quality of the design proposals submitted by the contestants is more in line with sponsor expectations. With broader innovation agendas, although the proposals are diverse, the entries lack design rationality and market demand due to the participants' limited understanding of products and industries. With narrowly-focused subjects, it is easy to compare and assess the innovativeness of the entries, and jury members' perspectives are more uniform.

4.2 Competition Participation

Through the design competition briefing session, contestants can understand the competition theme, market positioning, and user experience. However, design students lack understanding of technology and the market trends. Therefore, finalists will be invited to the technical seminars coordinated by the organisers to get advice from professionals. The professionals include senior designers, engineers, and marketing professionals.

4.3 The Competition Achievements

The product manager says that, although there are many innovative entries in the competitions, they lack alignment with the consumer market. The Tt Company CEO suggests that participants should make a preliminary analysis of their entries' market and user behaviours, and the entries that are submitted should comply with the company's existing product lines which have a precise marketing positioning to lower market risk. From the design students' side, obtaining suggestions on product design practices in the concept exploration phase is not only helpful for concept development, but also for design development by improving feasibility with advice from professionals.

5 Discussion

5.1 Participation in Design Competition Subject and Effect

With the competition development, participatory design methodology is increasingly applied in its process. This change has shaped the competition subjects from a broader new concept design to a narrowly-focused product design based on the company's innovative development strategies. With the subjects becoming more narrowly focused since the fourth competition, the participants are poised for in-depth exploration of user experience and behaviours. For example, there were three new concepts from the users' point of view in the fourth competition, one of which was a woman's perspective, which enlightened the company to evaluate the market demand of this customer group. These creativities are more likely to be feasible based on the company's existing product lines and are more likely to accelerate the company's new product development.

5.2 Participation in Design Competition Governance and Effect

The methodology of the participatory design of the Tt Competition corresponds to Spinuzzi's (2005) three basic stages: (1) Initial exploration of work; (2) Discovery processes; and (3) Prototyping. Tt Company holds brief sessions at the beginning of the competition to introduce the design subjects, its marketing position, and the collected user experience, to let contest participants know as much as possible about the proposed users.

Differing from a general design competition, as a collaboration-orientated competition, the design proposal development phase starts from the technical seminars, not after the winners are revealed, which is also beneficial to the company in terms of design proposal feasibility. On the other hand, these technical seminars have another important value for entrants. They benefit from education and professional development, and even have a chance to develop the entries into products. With mixed-good benefits, the promotion of a participatory design competition can be sustained, and it can increase the willingness of external resources to participate.

5.3 Participation in Design Competition Outcome and Value

In general, the internal new product development is based on the company's existing and familiar product lines, which have enough market research and technology support, but the creative concepts raised in the competition may be a totally new field for the company, which requires cost in regard to market research and investment evaluation.

As a participatory design project, the design competition is part of the research phase. Completed with the development phase, this innovation resource can be transferred to valuable innovation output. For the participating students, the complete and multi-faceted expert advice helps them to understand the role of the designer in the design project, how to cooperate with the relevant personnel to complete a creative design, and how to implement an innovative design from the corporate practice perspective.

6 Conclusion

In summary, participatory design competitions bring benefits to organisers and participants. The findings in the case study are highlighted as follows.

1. The theme of the design competition should be consistent with the company's innovative development strategy, and should be in an area in which the enterprise specialises. The narrow-focused subject, by providing a specific creative direction, tends to explore potential innovative proposals within the scope of a given topic. The participants' innovative proposals can have a high reference value for the company.

2. The technical seminars provide participants with industrial and technical support, which reflects collaboration and mixed-goods benefits for public and private entities. Through the design competition, Tt Company benefits from brand promotion and external design resources, while the design students benefit from design practice and education. However, in order to not interfere with the design concepts, it is suggested that the design seminars be held after the initial entries are reviewed.

3. The design proposal in the final assessment combines the entrant's original concept and the suggestions from experts, making it more mature and feasible than the initial review. The prototype provided in this stage is a necessary object to judge the final works, which makes the design concept complete and practiced, and promotes organisers, jury and participants to communicate, joint and explore further.

In general, the Tt Creative Design Competition is a positive example of integrating internal and external resources, with mutual benefits, which ensures that the competition continues to develop. The results of this study indicate that it is worthwhile to carry out further in-depth analysis of design competitions adopting the participatory method.

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Playing games with your mouth: Improving gaming experience with EMG supportive input device

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As the technology improves, video games are becoming more realistic, lifelike and complex than ever. Recent titles feature more choices and actions for players to interact with the virtual world, which requires more key presses and can make controlling the character harder than it need to be. We found that casual players often press the wrong key when the game gets intense due to pressure and casual players' inexperience, which result in frustration and loss of interesting in playing. This article pursues three interrelated goals. First is to present a new way of input which uses electromyography(EMG) to measure the user's mouth movement, allowing the user to control their in-game character or use specific game feature without traditional keyboard input, lowering the chance of mis-input and make playing the game more easy and intuitive. Second, comparing the strength electromyography has with other alternative input methods, especially mouth related control methods. The final goal is to find an optimal way to assist traditional keyboard and mouse layout, allowing players to easily immersive themselves in their game of choice.

Keywords: User Interface; Video game; Input method; User Experience

1. Introduction

In recent years, video game is become more popular than ever. With over 2.4 billion of active players and 115 billion U.S. dollars of revenue, the gaming industry is the 4th largest market in the world. As the technology advances, video games not only become more realistic, to further expand the depth of game and satisfy hardcore players, many new games also introduce more complex gameplay features. To access these additional features, more keys are required to fully enjoy the game, which limits the usability of console controller and may be difficult to understand for new players. To address this problem, we developed a prototype input method based on using electromyography (EMG) to detect the user's mouth movement, allowing them to access specific function in the game with subtle mouth movement such as grinding teeth.

There are currently a few products addressing this problem in different ways, such as "Tilted", a supportive input device which allows players to control their character with head movement. There are already studies and projects conducted on using biomedical signal to directly control video game for disabled users (Kawala-Janik, Podpora, Gardecki, Czuczwara, Baranowski & Bauer, 2015, p.2), but those projects mostly focused on replacing

traditional input method for users in need, not assisting traditional keyboard and mouse input.

Our goal is finding a new way to assist existing input methods such as keyboard and mouse, replacing complex commands on keyboard with simple mouth movement, lowering the gap between novice players and experienced players, allowing players to fully enjoy the game's feature and immerse themselves in the virtual world without having to overcome a steep learning curve.

In the introduction chapter, the theoretical notions and foundations of this research will be explained, including:

(1) Currently Available Alternative Input Method

(2) Controlling Video Games with EMG

(3) Using EMG to Assist Existing Input Method

1.1. Currently Available Alternative Input Method

Currently, there are a few alternative control methods designed to improve users' gaming experience or enable users with physical disability to access functions that they initially couldn't access.

In this article, we will discuss those alternative control methods and take a closer look at their associated problem, including tongue control, infrared switch and gesture control.

1.1.1. Tongue control

Tongue control system is designed for disabled users who suffer from spinal cord injuries to control wheelchair. With sensors embedded in the user's mouth, this system allows the user to control wheelchair invisibly. By keeping tongue in touch with palate, the system will emulate an analog joystick, thus allows multidirectional control of the wheelchair(Lund, Christiensen, Caltenco, Lontis, Bentsen & Andreasen, 2010, p.3362)

Another system named Tongue Drive System (TDS) provides a wearable solution to Tongue contro(Kim, Bruce, Sutton, Rowles, Pucci, Ghovanloo, 2015, p.2). TDS is a wireless system which uses magnetic tracer temporarily attached to the top surface of the tongue with tissue adhesive to track user's tongue movement and translate it to user-defined commands, allowing user to interact with smartphones and personal computer only with their tongue.

Figure.1 In-mouth control grants spinal cord injured users a way to interact with computer
Source: assistivetech

1.1.2. Infrared switch

Infrared Switch is used by prestigious theoretical physicist Stephen Hawking. Suffered from amyotrophic lateral sclerosis (ALS), he had little control over his muscles, keeping him from typing or clicking buttons. This system mounted on his spectacles can catch twitches or movements in his cheek, combined with an interface called EZ Keys, he is able to move the cursor on screen through columns or rows, and stop the cursor with a twitch of his cheek.

1.1.3. Gesture control

Gesture control is the most commonly used alternative input method by general public due to its ease of use and relatively low cost. Since the late 1990's, gesture control has been a major development goal, using motion detect devices or other peripheral, gesture control systems can analyze user's body movement and translate them into in-game action. Currently, Xbox's Kinect system is one of the most popular full body gesture control solution for basic research use(Zhang, 2012, p.5).

Figure.2 Kinect is one of the first consumer product that successfully brings full body control to public market
Source: Microsoft

1.2. Controlling Video Games with EMG

Some studies have been done on controlling video games with biomedical signals including EEG and EMG, but those studies usually focus on implanting biomedical signal controller for medical and rehabilitation use(Brianna,2017). These control methods make it possible for disabled users to enjoy games as all other players. These input methods are designed for disabled users to replace traditional mouse and keyboard layout, and have a relatively limited versatility, most of the ordinary gamers have little use for these kinds of input device.

Figure.3 EMG input makes controlling video game possible for physical disabled users
Source: Brianna LaBelle-Hahn

1.3. Using EMG to Assist Existing Input Method

Though replacing typical keyboard and mouse layout with alternative input method such as gesture control may be fun or even more immersive, but the lack of accuracy and need of space prevents it from taking over the role of the main mean of input in gaming sessions.

Many veteran gamers express that quick and accurate input is essential for good gaming experience. Because of this, EMG control which requires specific training and provides less input commands should not be replacing traditional keyboard and mouse layout, instead, we can use a simplified version of it to assist existing input method, improving user's immersion, providing more intuitive ways to access certain gameplay functions and will not drastically alter user's primary way of input and cause inconvenience in gaming sessions.

2. Background

Keyboard has been a standard input method for personal computer since its debut, when talking about playing video games, other than using keyboard and mouse, game controllers are also used by a large portion of the whole user base. In recent years, as technology advances, many new and creative control methods hit the market, such as Wii's motion control and Kinect's gesture control. These new control methods provide users new ways to interact with their games, but some of them suffer from inaccurate input detection, making these input methods not suitable for hardcore gamers and more competitive game genres.

2.1. Typical Mouse and Keyboard Layout

In the 1990's, operating system has changed drastically due to the introduction of graphic user interface (GUI). GUI changed the way users interact with their computers, using a mouse to navigate has become a necessity for the majority of users. Since most of the users are using keyboard and mouse as their primary input method, game developers started to implement mouse support into their games. Other than that, the 1990's saw a new genre of games in desperate of a new and precise control method – first person shooter (FPS). Using a mouse to navigate 3D environment and aim provides a natural and precise experience.

Figure.4 With more keys on the keyboard than on the controller and more intuitive mouse movement in 3D environment, mouse and keyboard quickly became the new main input method in PC gaming
Source: stickpng

2.2. Modern Games with Complex and Realistic Features

With the rapid advance in technology, video game designers are able to create a more realistic game world and add more detailed gameplay features. Take first person shooter as an example, early games only feature basic functions such as walk and shoot, games nowadays allows player to fully control their character, players are able to peek through

corner by leaning, change to different stances, aim with their weapon and perform more even sophisticated actions. These advanced mechanics not only increased the game's fidelity, but also heightened the skill ceiling of the game, veteran players are able to utilize these mechanics to their advantages, making the game more challenging and exhilarating, yet require new players to invest more time practice with new mechanics.

2.3. Alternative Input Method Designed for Disabled Users

Many of the alternative input methods are designed for disabled users, due to their lack of ability to use traditional keyboard and mouse layout as their primary way of input. To make controlling computer possible for disabled users, these alternative input methods usually don't require direct hand input, such as EEG, EMG or tongue control, duo to the method of input itself, the complexity of inputs are still relatively limited compare to their keyboard and mouse counterpart, which make these input methods not useful for other users.

Recently, Microsoft announces a new accessibility controller which allows users to individually bind every controller input with a wide range of input devices, making it a central hub for all the inputs. The capability of hooking up with other input devices makes it a optimal way for disabled users to enjoy most of the popular games today, but some PC based simulation titles still require more keys to be fully enjoyed.

Figure.5 The new Xbox accessibility controller aims to provide handicapped users a new way to interact with their game console
Source: Microsoft

3. System Structure

The EMG supportive input device contains 2 parts, frame and electronic components.

The frame is made of stereolithography processed 3D printed plastic. Model after wireless behind-the-head style headphones, the frame features light weight and ergonomic design, allowing users to wear this device in long gaming session with comfort.

The electronic components are based around Arduino, with 2 electromyography sensors attached to the main Arduino system can make use of the electromyography signal provided by 2 signal receiver patches sticking on user's face to monitor user's mouth movement. After collecting user's mouth movement signals, the program can translate those signals into input control, allowing users to make direct control input with mouth movement.

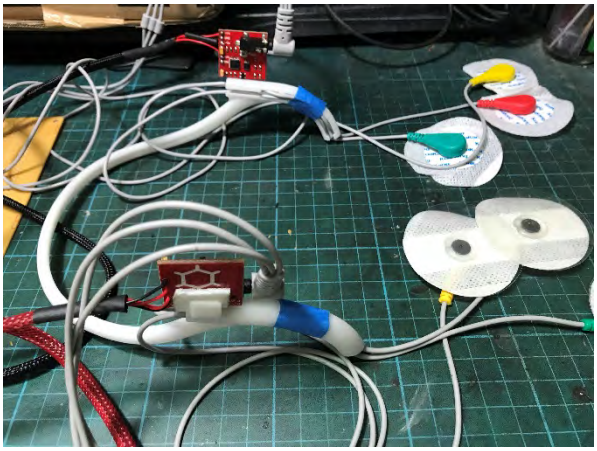

Figure.6 The frame collects all the wires and make the sensors in place

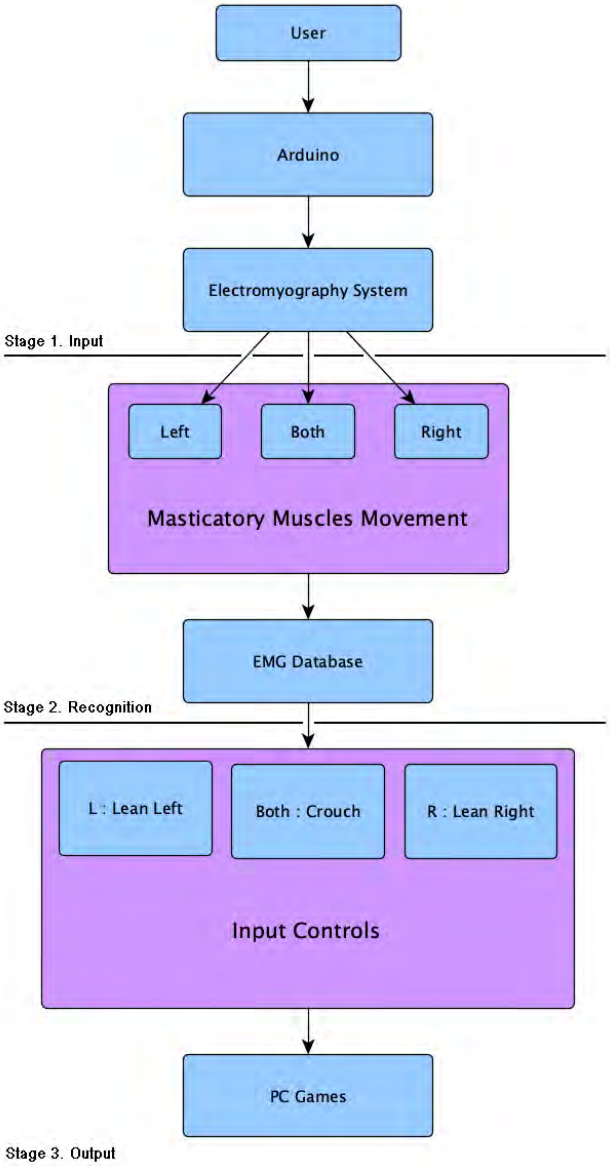

Figure.7 The structure map of EMG input hardware design

4. Experiment and Methods

4.1. Participants

The participants were selected from university students and will be separate into 2 groups, inexperienced and veteran. Players having less than 1 year of FPS experience will be considered inexperienced (Group A), and veteran group (Group B) requires players to have over 5 years of FPS experience. Making the experience gap larger allows us to better understand the different in players having different experience level. Inclusion criteria for all participants includes being fluent in Chinese and being in age of 18 to 30 years old, gender is not taken into consideration. There are total of 21 participants signing up for this experiment, 2 participants were excluded from the study for being older than 30 years old, and 5 were excluded for having more than 1, but less than 5 years of experience., making the final sample size 14 (Group A: 8, Group B: 6), and all participants are male.

4.2. Materials

The whole experiment contains 3 separate phases, pre-test, controlled test and field test. In the first phase, we created a simple program that ask participants to bite with either left or right side of their mouth in random order and record participants' response time and accuracy for us to find the best sensor placement and force threshold.

In the second phase, we developed a test program with Unity, providing participants with a controlled and pressure free environment to familiarize themselves with the device. This program only tasks participants with one objective: lean the player character's body to the side which light turns green from red. This action doesn't require input other than EMG, grinding teeth in certain direction will make the player character lean to that direction, participants have to utilize EMG control to complete the objective.

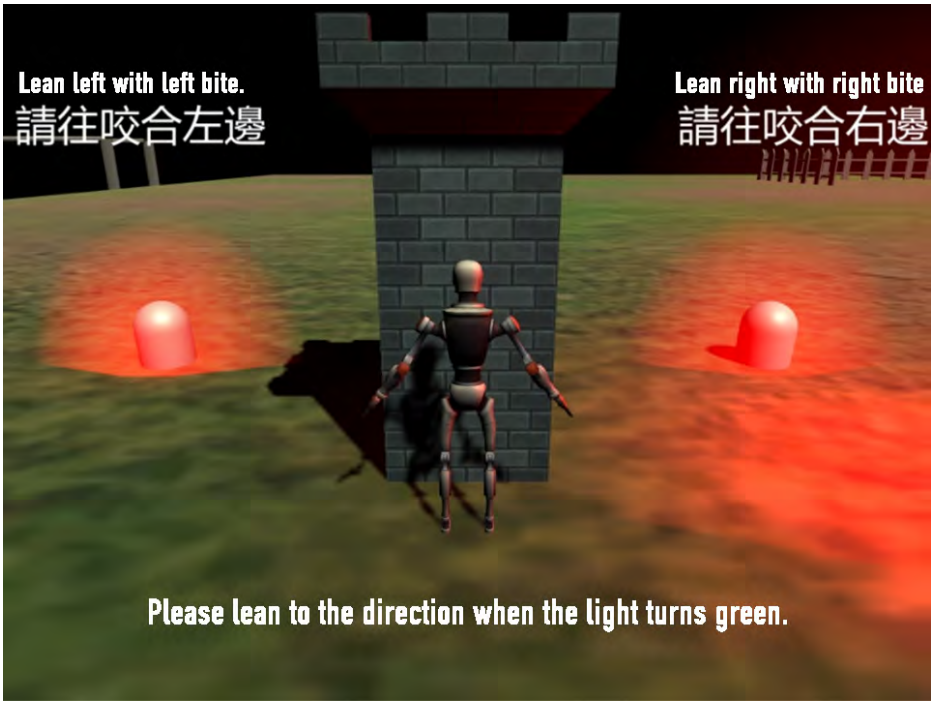

Figure.8 A screen shot of phase 2 test program

The final phase requires participants to utilize EMG control in real gaming situation, testing the usability of EMG input in intense scenarios. We choose "Player Unknown's

Battlegroudns” as our testing material, since this game is one of the most popular game in FPS genre and features more advance mechanics including leaning and toggling weapon firing modes.

4.3. Procedures

The experiment has 3 different phases, pre-test, controlled test and field test. The goal of the first phase is finding out the optimal position for sensor placement and pressure threshold. Participants have to place sensors in 3 different ways and complete the same objectives to compare the different in sensor placement. This phase requires all participants to try out 3 different sensor placement for 3 times each, and each time requires 10 inputs to complete. The first two times are the same, instructing participants to get used to EMG control by asking them grind their teeth one side then the other side alternately, the third time requires participants to follow the order which generates randomly.

With the knowledge of first phase, we can proceed to the next phase. Phase 2 tasks participants to control a game character with EMG input only to simulate gameplay condition in a controlled environment. Using the specially designed application, participants can lean the player character’s body with EMG input system. Participants have to lean the character’s body toward the direction with green light. Same as phase 1, this phase also will be repeated for 3 times, the first two-time signal lights will turn green alternately, but the last time is randomized, participants have to react to the light’s changing themselves, keeping them from predicting which light is going to change. After this phase completes, participants are asked to do the experiment one more time with mouse for response time reference.

Figure.9 A participant in phase 2 experiment

Final phase tasks participants to utilize EMG input system with traditional keyboard and mouse input together in real gameplay scenarios. Participants will be playing “Player Unknown’s Battlegrounds”, one of the most popular FPS game in recent years, with the new input system. The EMG signal is bind to leaning action, the same as phase 2. This phase will last for 4 weeks, every participant is asked to play for one hour every week. After the whole phase comes to an end, a post-test questionnaire will be distributed and a focus group meeting will be held.

5. Conclusion and Limitations

5.1. Conclusion

In the first phase, we found that in general cheek area, sensor placement doesn't' have a big impact on signal strength as long as two sensors has at least 5cm between each other. The second phase shows that using EMG control makes response time slightly longer than mouse. Except for one participant with significant higher peak signal strength (200mv), most of the participants has an average of 43 mV.

After the third phase ended, group A participants expressed that using EMG to control increases their probability of using leaning mechanic and is more fun to play, yet group B participants generally prefer accessing functions with traditional keyboard input. While most of the participants didn't encounter problem wearing the device, but 3 participants wearing glasses expressed that wearing the device with glasses and headphone on may be uncomfortable in long gameplay session.

Table 1 Phase 2 EMG supportive input system performance chart

	Group A (Inexperienced)	Group B (Veteran)
Average Response Time with EMG	435 ms	373 ms
Average Response Time with mouse	352 ms	274 ms
Average Peak Signal Strength	42 mV	43 mV
Average Accuracy	92%	94%

5.2. Limitations and Possible of Future improvements

Because of limited time and resource, we only have 14 legitimate participants, and all of them are male. In future research, to further expand the scope, the next step is to recruit more participants including female participants.

Other than the experiment itself, the structure of the device still need some improvements. 3 glasses wearing participants addressed wearing the device with glasses and headphone on for a long time may be uncomfortable. A new design which can adapt to headphone or a system combining headphone and EMG input system is needed.

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Reviewing Design Movement Towards the Collective Computing Era: How will Future Design Activities Differ from Those in Current and Past Eras of Modern Computing?

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This paper aims to envision design activities –design task, design process, and designer– for the collective computing era, an upcoming dominance of applications where many people interact with each other through many computing devices (Abowd, 2016). To achieve this aim, the typical design activities over the last two computing eras, personal and ubiquitous, are studied through a literature review. Based on the activities shift discovered there, new design activities for collective computing are envisioned. This study urges designers to change the way to work with user-data: from referring the small but in-depth ethnographical user-centered living-lab data (during the ubiquitous computing era), to create an understanding about both the individual user and the society or crowd as a whole (collective computing era). These different types of data provide designers with a rich understanding on the users in their contexts, both as individual and community levels. Also, the design process that authors envision is a process of co-exploration (merge of problem exploration and solution delivery), and co-evolution (the constant reflection back and forth with exchange of information) of design problem and solution spaces. Moreover, the designers in collective computing era have to take ethical and privacy issues into account. They have to create plans for dealing with the uncontrollability of the data generated and uncertainty about the social impact of the design that come with it. This research can trigger the designers to innovate and remodel their work at the forefront of new computing technologies.

Keywords: envisioning new design activity; reviewing design movement; modern computer development; collective computing;

1 Introduction

When Bayazit reviewed the last forty years of design research, she mentions that there is ‘a close relationship between design research and the development in the IT field’ (Bayazit, 2004). As an illustration of this, Dubberly noted that networked computers have changed what designers make and the ways designers think (Dubberly, 2008). What both argue is that design activities evolve in a relation to developments in modern computing, where the first generation were mainframes; the second personal computers; and the third defined by ubiquitous computing (Pew, 2002; Want, 2010). For the future, a fourth generation has been

proposed as ‘collective computing’ (Abowd, 2012, 2016). Since designers have played increasingly active roles in bringing about the previous eras in modern computing, authors believe that the role of design is now likely to change again with the advent of the coming era of collective computing.

The goal of this paper is to envision the new design activities – design task, design process, and designer – for the upcoming era of collective computing, defined by a shift towards multiple interactions between many users, occurring through many computers (Abowd, 2016). In order to achieve this goal, authors first provide a literature review of how design activities have been executed in a relation to the current and past eras of modern computing, focusing on personal and ubiquitous computing. Based on this review, authors then create a vision, future design activities, for the upcoming collective computing era. This vision is presented in a framework (Figure 1) that compares past, current, and future design activities in a relation to developments in modern computing.

The envisioned design task in collective computing era is to design (for) an ever-evolving complex system. User studies are still needed to tackle this complexity, but these can now be done through the integration of community and individual levels of user data. The envisioned design process is co-exploration and co-evolution with changeable problem and solution spaces, due to the real-time-contextual data collection and solution delivery. In addition, designers are envisioned to be attentive on ethical and legal (privacy) issues by considering a governance structure at the societal level to help prevent uncontrollable misuse of data.

This paper provides designers the practical and explicit action points to start designing specifically for collective computing. Thus, this study triggers the designers to innovate and remodel their work at the forefront of new computing technologies.

2 The Framework Development: Design Activities in a relation to Modern Computer Development

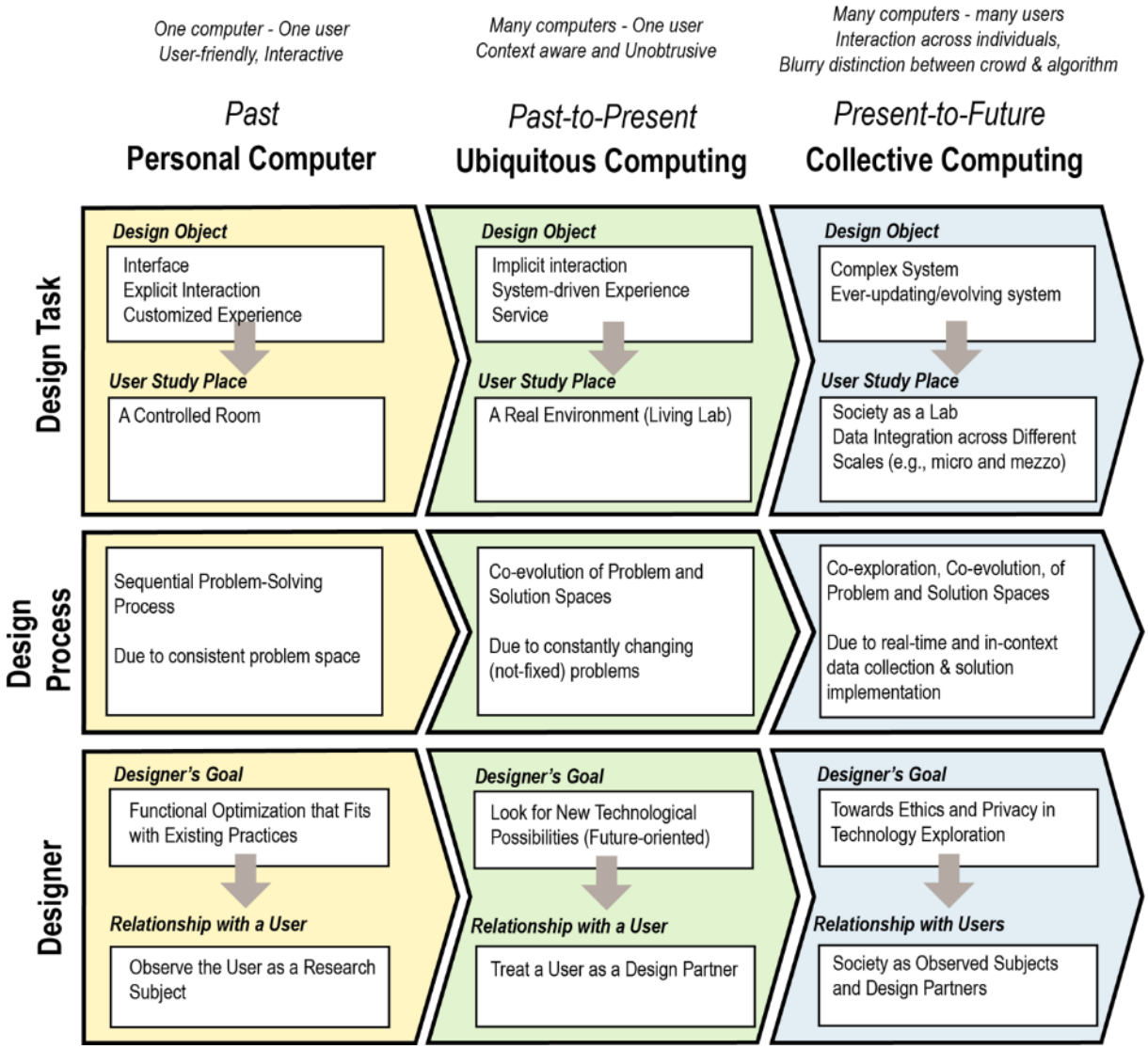

Figure 1. Framework describing Design Activity Changes in a relation to Modern Computer Development

The horizontal axis of the framework distinguishes three computing generations derived from Weiser (Weiser, 1991), and Abowd (Abowd, 2012, 2016): (1) personal computer era (past), (2) ubiquitous computing era (past-to-present), and (3) collective computing era (present-to-future). Although the literature starts with an earlier mainframe era, we excluded it from the framework, because designers were not that much involved in, and influenced by developments of mainframe computers. The vertical axis lists three groups of design activities -design task, design process and designer- which are based on Dorst's argument on the nature of design methods and techniques (Dorst, 1997). According to Dorst, the basic elements of design methodologies are not only design processes, but also design activities that include dimensions of design task and designer.

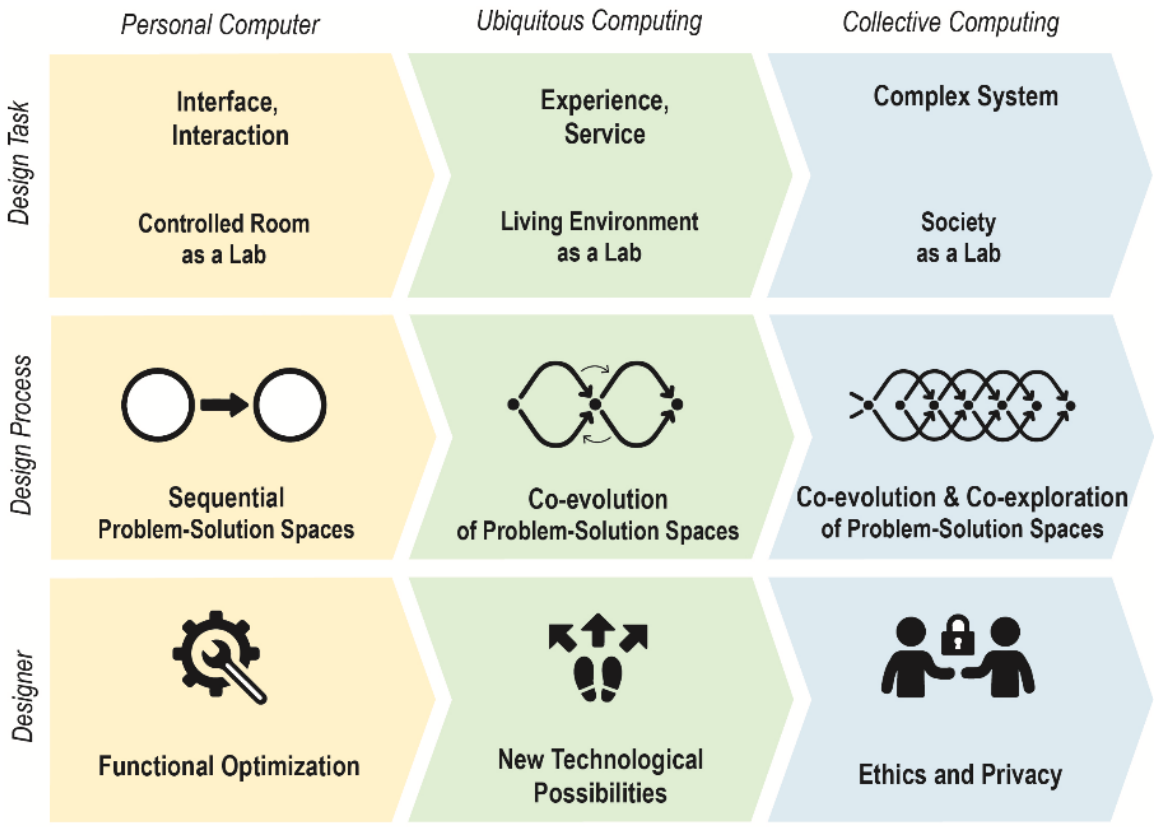

Figure 2. Framework describing Design Activity Changes in a relation to Modern Computer Development, Simplified Version

3 Past: Personal Computer

3.1 Brief Product Characteristics of Personal Computer

This brief explanation about personal computer (PC) era is based on the historical reviews of Human Computer Interaction evolution by Pew, and Grudin (Grudin, 2008; Pew, 2002). The PC era started in the beginning of the 1980s as a result of two technological developments. First, companies started introducing less expensive but highly capable mini computers on the consumer market. Examples are the IBM PC 5150 in 1981, Xerox Star 8010 in 1981, and Apple Lisa in 1983. Second, the public commercial Internet was released in 1989. With these technological aspects, not only programmers, but also everyday people started to use the computers for work efficiency and entertainment. The release of the Internet also brought various Internet-applications such as instant-messaging, music players, and weblog tools. Also, asynchronous and distant communication, such as online discussion and email, became mundane.

As a consequence of the everyday use of PCs, there was a need for user friendly computers. This is because the everyday users had little to no formal training in the use of PCs. Therefore, the structure and flow of the computer system interface had to be intuitive so that users would not feel frustrated or confused when using PCs (Grudin, 2008; Pew, 2002). A PCs superiority in user-friendliness and intuitiveness became the key selling point for all computer vendors. Moreover, users no longer had full control over computers as they had had with mainframes. Instead, they interacted with the computers through an affluence of software and Internet applications (Ritter, Baxter, & Churchill, 2014).

3.2 Design Task

Design Object: Interface, Explicit Interaction, Customized Experience. During the PC era, it became more and more important for companies to compete on the user-friendliness of their products (Grudin, 2008; Pew, 2002). This created possibilities for designers, since they were known for considering human factors during their (product) design works (Löwgren, 1995; Pew, 2002; Shneiderman, 1980; Winograd, 1996). The role of designers was also amplified through the increased importance of Graphical User Interfaces (Burns, Cottam, Vanstone, & Winhall, 2006; Winograd, 1996). Consequently, designers were equipped with the design of graphical interfaces (e.g., icon or web interface), explicit human-computer-interactions (e.g., natural usage of menu selection), and customization-based experience (e.g., providing an option to change the interface color, based on personal preference).

The designer's attention further widened to the people's interaction with PC or Internet applications (March, 1994; Zimmerman, Forlizzi, & Evenson, 2007). During the PC era, companies such as Intel, Thomson Consumer Electronics, and Apple changed their view on usability by paying more attention to the user experience. Design for experience included both 'how logical and natural a product is to use?' and 'how people feel about using it?' (March, 1994). In 1996, at the COMDEX computer trade show, an Intel chairman mentioned for example that 'Intel is not a company simply selling personal computers but now it is the business of delivering information and interactive experiences'(Pine II & Gilmore, 1998). Some software functions at that time could be customized by users according to their preferences and needs, such as creating shortcut icons, and changing the color of the interface (Lee, 2013).

The role of designers in the PC era expanded substantially with the release of the Internet (Grudin, 2008; Pew, 2002; Ritter et al., 2014). This is because the design and architecture of webpages or software applications were directly related to information retrieval time. Internet applications such as World Wide Web (www), email, and online games created a lot of attention from users, because it changed entirely the ways users work, communicate, and entertain themselves. This created new interaction and experience design opportunities considering the user psychology in building computer design (Winograd, 1996). As a result, in the mid-1990s, designers took over the most roles of software design from the software programmers because the designers created the interfaces in more imaginative and innovative ways (Abowd, 2012).

User Study Place: A Controlled Room The designers of PC conducted their user exploration mostly in a controlled room, so called laboratory format (Hughes, King, Rodden, & Andersen, 1994; Rogers, 2011). The controlled room format was appropriate for conducting user studies of design interface and explicit interactions. This is because the design areas dealt with certain moments in computer usage, such as the moment of finding menu button on screen (Mayhew, 1999). The lab format kept users from being distracted or from anything else that could confound the user testing results (e.g., family assistance, etc.) (Rogers, 2011). This approach allowed designers to achieve their goal of functional optimization with objective, numerical results.

3.3 Design Process

Sequential Problem-Solving Process A dominant view of the design process in product and software design is 'the design as a problem-solving process' (Lawson & Dorst, 2013;

Shneiderman, 1980; Simon, 1988). Problem and solution spaces in the design process were seen as independent and could therefore be handled sequentially. A likely reason for this is that the problem space in PC design was often already defined and formulated by software developers, as a form of user-requirements (Burns et al., 2006; Pew, 2002). Thus, from the start of design process onwards, designers often were already dealing with relatively well-defined and consistent design problems, which were often about usability efficiency (Jokela, Iivari, Matero, & Karukka, 2003). On the basis of this, the designers often provided solutions to improve the efficiency and provide functional optimization, through lab-based usability studies (Ritter et al., 2014). This design process also fitted in a company strategy clearly separate tasks between software engineers and designers.

3.4 Designer

Designer's Goal: Functional Optimization that Fits with Existing Practices The designer's goal in the PC era was functional optimization of current practices, and evaluation of final design proposals (ISO/IEC., 1998; Ritter et al., 2014). The goals of functional optimization in software design meant to have simplicity, power of command, user satisfaction, and reasonable costs to sustain the system (Shneiderman, 1980). With the designer's goal of functional optimization, design standards, structured principles, and guideline were often developed to guide other designers to improve the user experience of user interface (Ritter et al., 2014; Shneiderman, 1980). Examples are 'criteria for effective interaction design' by Alben (Alben, 1996) and 'Macintosh human interface guideline' by Mills et al. (Mills, Bonn, & San Juan, 1992).

Relationship with a User: Observe the User as a Research Subject To achieve the designer's goal of functional and experience optimization, designers carried out controlled usability studies, in which they observed users in practices that they simulated in a laboratory setting (Rogers, 2011; Sanders, 2006). From these controlled settings, designers derived insights about the potential for optimization, which they formulated as design requirements (Abras, Maloney-Krichmar, & Preece, 2004; Sanders, 2006).

4 Past-to-Present: Ubiquitous Computing

4.1 Brief Product Characteristics of Ubiquitous Computing

Ubiquitous computing was firstly coined by Weiser in 1988 (Weiser, 1991), and started to attract a lot of attention in the 1990s when companies started to explore the potential of small networked portable computer products. Examples of products that resulted from these explorations are Appel Newton, EO pad, Palm Pilot, and Sharp Zaurus (Grudin, 2008; Pew, 2002; Want, 2010). Ubiquitous computing got past its exploratory stage and became adopted by markets in the 2010s (Want, 2010). From that period onwards, users owned many computers such as smart phones, PDAs, and embedded computers. The miniaturization of computers pushed the rise of ubiquitous computing. Moreover, cheap sensors, actuators, and easy programming platforms lowered the barrier for developing embedded computing applications (Grudin, 2012; Pew, 2002; Want, 2010).

The two main characteristics of ubiquitous computing are context awareness and unobtrusiveness (Grudin, 2012; Pew, 2002; Want, 2010). Context awareness means that devices can incorporate the user's context into their operations, in order to provide the best possible user experience. To create contextual awareness, developers use on-platform sensors that can detect for example the location of a device, others devices close by, as well

as environmental factors such as sound, motion, and temperature (Grudin, 2012; Pew, 2002; Want, 2010). Unobtrusiveness refers to the seamless integration of computers with everyday objects such as a table or a floor matt (Barton & Kindberg, 2001; Kidd et al., 1999). Therefore, a key quality of ubiquitous computing products is that they allow users to use the product unobtrusively without becoming detached from their surrounding context (Grudin, 2012; Pew, 2002; Want, 2010)

4.2 Design Task

Design Object: Implicit interaction, System-driven Experience, Service. The tagging and sending technologies of ubiquitous computing have created a thin line between the digital and physical world (Want, 2010). Since computers have become portable, designers could not limit themselves to explore user's behavior only on digital activities anymore. They also have had to consider the user's physical activities. This has even led to new human-computer interactions such as gesture design for wearable devices and voice user interface for AI speakers (Helms, Brown, Sahlgren, & Lampinen, 2018; Maeda, 2018). Designers have aimed for these kind of interactions to create unobtrusive yet engaging user experiences with the product that does not demand the constant input or attention of users (Ju & Leifer, 2008). The interaction has happened without the explicit command but with awareness of user' natural behavior and context (Ju & Leifer, 2008). An example is the Google Nest which is a product that can automatically change the temperature in a house based on the predicted presence of its inhabitants by anticipating their needs (Helms, 2017; Helms et al., 2018). The main challenge for designers to create human-product/computer interactions in the ubiquitous computing era has been the implicitness of the interaction to be developed. To deliver a holistic and univocal experience, designers have started to develop tools and methods to systematically deliver a personalized user experience that infers the user's implicit needs, preference, and traits (Lee, 2013; Tseng, Jiao, & Wang, 2010). Moreover, the product automatically tailors to the user's behaviors during product use (Pariser, 2011). These advanced human-computer interactions have increased the attention on experience design and triggered the development of service design in the 2000s (Lee, 2013). This is because during the ubiquitous computing era, the device itself does not mean much, but service systems around the device have acquired a greater value-in-use. After being a new design discipline for 20 years, service design is now entering a stage of young maturity (Secomandi & Snelders, 2018).

User Study Place: A Real Environment (Living Lab) Designers in the ubiquitous computing era more often conducted user research in the actual living environment of users, because they aimed for an unobtrusive user experience with greater context-awareness (Brush, 2016). They often conducted these user studies in close collaboration with computer scientists. Together they created so-called living labs (Rogers, 2011; Taylor, 2016). A famous example is ENoLL (European Network of Living Labs). One of the projects they have done is the Mobile City Bregenz project where they provided mobile broadband infrastructure to explore new innovative public services (Dell'Era & Landoni, 2014). Aware Home(Kidd et al., 1999) and the Cooltown project (Barton & Kindberg, 2001) are traditional examples of living labs where they explored how embedded computational technologies implemented in the home could support everyday activities of users. These kinds of user studies in real environment allowed for explorations of how users behave naturally, in computer enhanced environments. Thus, it allowed designers to explore the user's longer journey of using computing devices in computer enhanced environments, instead of

exploring only a single moment of use as in the PC era. An example is the exploration of the use of wearable devices throughout a day in the user's life, which is very different from studying the moment of touching a menu icon on a screen. Thus, user studies have been conducted more natural ways with less intrusion by researchers.

4.3 Design Process

Co-evolution of Problem and Solution Spaces The miniaturization of computers, and the inherent embedding of computers in everyday practices, have increased the degrees of freedom in the design of human-computer interactions (Want, 2010). The design problem in such a complex context cannot be fixed or defined at certain point of design process, but it constantly evolves and changes (Dorst, 2006; Hatchuel, 2001). Therefore, designers constantly refine the design problems and solutions 'through the constant iterative analysis, synthesis, and evaluation between problem and solution design' (Dorst & Cross, 2001). Accordingly, the two design spaces -defining a problem and delivering a solution- constantly change and influence each other. Design researchers termed this as the co-evolution of problem and solution (Burns et al., 2006; Dorst, 2006; Dorst & Cross, 2001)

4.4 Designer

Designer's Goal: Look for New Technological Possibilities (Future-oriented) The designers in the ubiquitous computing era have explored new technological possibilities that can change and even disrupt user behavior, instead of optimization solutions for present-day problem (Brush, 2016; Rogers, 2011). This exploration of future-oriented possibilities has led designers to popularly be involved in speculative design, that talks about the implications of emerging new technologies (Dunne & Raby, 2013). The speculative design, so called design fiction or critical design, is a mean of speculating how things could be, so design becomes provocative rather than predictive or prescriptive (Dunne & Raby, 2013). This designer's future-oriented goal has become possible with the technological development such as actuators, sensors, and easy-programming tools. With such interest, design for ubiquitous computing has not attempted much to develop theories, but to apply technologies in practices (Hekkert & Van Dijk, 2011), and credit the investigation on novel interaction or experience of emerging technology's applied practices (Brush, 2016).

Relationship with a User: Treat a User as a Design Partner The future-oriented designer's goal aiming to explore new technological possibilities has opened-up the relationship between users and designers, since designers have valued the natural use behaviors and opinion of end-users. Consequently, designers have started seeing the users as partners in design process and they have popularly done co-design (Sanders, 2006). Co-creation processes provided designers not only with information on what users can verbally explain what they want, but they create a deep understanding of user needs and behaviors (Sanders, 2006). Through co-design, designers have created empathy for the users, meaning that designers understand the user's hidden needs and behaviors. Moreover, users became innovation sources and unique insight providers. This means that design for ubiquitous computing has moved from user-centric (for users) to user-participatory (with users) (Dell'Era & Landoni, 2014; Sanders, 2003, 2006).

5 Present-to-Future: Collective Computing

Multiple scholars argue that 'collectiveness' is the future driver for computing (e.g., (Abowd, 2016),(Mulgan, 2017),(Oswald, 2018)). However, since the collective computing is a

relatively new concept, there is only limited literature available. Therefore, this section is a combination of existing literature and our own ‘meta-speculations’ about the role of design in the collective computing era. Our ideas stem from an extrapolation from the historical overview on the design activities in the PC and ubiquitous computing eras.

5.1 Product Characteristics of the Collective Computing Era

Abowd describes collective computing as the era or situation where many computers are owned and used by many people (Abowd, 2012, 2016). In other words, many people interact with many other people through multiple computing devices. There are three technologies that enabled the collective computing: the cloud, the crowd, and the shroud. The cloud is about limitless computation and data storage and access. The cloud supports the integration of different types of data generated through the use of different devices. The crowd is thousands of individuals who complement computer algorithms by providing human computation, cooperatively adding human intelligence. The shroud is a layer of digital technology that connects the physical world to the digital world by continuously updating and reacting to the changes made in physical world. It merges the people’s physical data to digital domain through cloud and computing devices.

According to Abowd, collective computing aims to have the human to human interactions between many individuals mediated by multiple computer devices (Abowd, 2012, 2016). This results in societal and community-level research. It allows people to have large data-sets from the start, without long training periods, to ready-to-use systems. Thus, data gathering from the crowd is a core value here. Data can be generated through people’s active contribution (e.g., Wikipedia or open-source software), or unobtrusively collected through cameras and sensors. Google Maps is an early example of collective computing, suggesting best driving routes by collecting real-time traffic information from the crowd using GPS on smartphones or sensors on buses, with many individual users having provided inputs (Abowd, 2016; Mulgan, 2017).

5.2 Design Task

Design Object: Complex System (Ever-updating/evolving System) The relationship between many users and multiple devices in collective computing naturally extends design object boundaries to allow for complex system design. This means designers contribute to upcoming large social and economic challenges (e.g., healthcare, environmental issues, sustainability, crime). Currently designers have started to solve the challenges with computational technologies such as e-Health emerged. Thus, design in collective computing can be regarded as designing (in and for) the complex systems that have an impact on society as a whole, instead of on individual users. The involvement of multiple users at the societal level means that the multiple layers of social and economic contexts become a part of the design task.

Further, the systems have the abilities to constantly update and evolve, based on user-data collected. In other words, systems are now adopted to users’ usage behavior and modify its system. As Fischer and Giaccardi mention, system cannot be completely designed prior to use; they must be evolved from users’ actual use (Fischer & Giaccardi, 2006); ‘the information and functionality in system can never be complete because the user behaviors change and new requirements emerge.’ This is because the users’ understanding and use of a system will be very different as time passes.

User Study Place: Society as a Lab (Acquiring Community Data) Because of the contextual complexity designers face in the collective computing era, designers need to have a deep and overarching understanding of users. Thus, designing complex system requires to acquire both societal and personal understanding about users (Whitworth, Ahmad, Soegaard, & Dam, 2006). Collective user behaviors such as social dynamics or collective goals are importantly considered, in addition to personal user behaviors such as individual user psychology or interaction behavior with computing devices (Whitworth, 2011). Thus, designers also have to think about issues of scale, and ask a question such as 'how can we apply this specific technology in a large network of interconnected systems, potentially with billions of users and across diverse contexts?' (Brown, Bødker, & Höök, 2017; Gardien, Djajadiningrat, Hummels, & Brombacher, 2014; Maeda, 2018). Design in collective computing means designing the complex systems that have an impact on society as a whole, and the individual users collectively. Thus, the notion of a 'lab' now extends to the community and society.

To achieve these goals, designers need to consider to integrate different scales and abstractness of data in their user studies. There are some researches that tried to complement different scales and abstractness of data each other and blend into one another. One known approach is 'a thing-centered approach' introduced by Kuijer et al. (Kuijer, Nicenboim, & Giaccardi, 2017). The thing-centered approach includes things (products) in the ethnography by embedded sensors and cameras on the thing. Consequently the thing can observe and record what happens around them (Giaccardi, Speed, Cila, & Caldwell, 2016). At the same time the thing can interpret the data through machine learning. Kuijer et al. applied the thing-centered approach while designing socio-technical systems for elderly people. The paper argues that machine learning techniques in user study can provide a novel way to uncover patterns in data, because it can gather the data beyond the human capacity and skills. Another example of the thing-centered approach is the 'Listening to an Everyday Kettle' project in which designers, ethnographers, and computer scientists worked together to speculate how ethnographic data and machine learning data can complement one another in design process of creating more meaningful IoT products (Clia et al., 2015) . They discovered that ethnographic data initially lead to questions that could thereafter be studied with machine learning techniques. Subsequently, ethnographic research could support the interpretation of the data generated through machine learning since ethnographic studies include a holistic picture of socio-cultural situations.

5.3 Design Process

Co-exploration and Co-evolution of Problem and Solution Spaces Design problems are complex in the collective computing era: messy and ambiguous in nature, and with each complex problem connected to other problems. This is because the design task, designing complex systems, is ever-becoming and continuously updating based on new user behavior data collected. Also, the ways to solve design problems are only knowledgeable and constructed in the mid of the design process (Fischer & Giaccardi, 2006). This means that the problem- and solution spaces of design process do not only co-evolve together with interchange of information (Dorst, 2006; Dorst & Cross, 2001), but they also have to be explored together (Stienstra, Bogers, & Frens, 2015). In other words, designers implement possible design solution in an actual environment as soon as possible, and disrupt the solution at multiple levels (e.g., economic, cultural and organizational). Only then, the

problem can be observed and explored to propose new solution based on the problem observed. Thus, the designers let the design problem and solutions to co-evolve first, then they explore which solution is needed due to the new problem observed.

Some design researchers provide the guidance on how to do this, such as Stienstra et al.'s work of Double Loop of Exploration (Stienstra et al., 2015). In the 'Double Loop Exploration' method, designers reflect in real-time on the data derived from user studies in the user's context (Stienstra et al., 2015). While reflecting on the data, they detect design problems to tackle that they directly solve and deliver to the user's context. Implementing solutions lead to a redefinition and/or refinement of the problem which lead to a new problem-solving loop. In this way, the problem space and solution space merge and get coupled to each other; it becomes hard to separate the two spaces.

Practical example is Connected Bottle project of Philips Design and Eindhoven University of Technology (Bogers, Frens, Kollenburg, Deckers, & Hummels, 2016; Van Kollenburg et al., 2018). The project is an actual project in industry (executed with real users in their natural habitat) that embraces the idea of co-exploration and co-evolution of the design problem and solution. To do so, the design team created a smart baby bottle hood that allows them to remotely collect the real-life baby bottle feeding data. The designers could see the feeding data in real-time and continuously on their computers. They used an algorithm that visualizes the data as soon as it is collected: time of feeding, movement of feeding, temperature of milk in bottle. Then, the designers quickly ideated new design problems, and provided users with newly modified design solutions. This phase was repeated multiple times. In other words, the designers implemented their design ideas and insights to the system, as soon as the data are collected so the users could experience the changes in the design right away and change their behavior accordingly.

Designer's Goal: Towards Ethics and Privacy in Technology Exploration Designers of collective computing contribute to changes to complex systems that can have a large impact on society. Taken together with the constant co-evolution and co-exploration of design problems-solutions in complex contexts, this creates a situation in which designers cannot fully control the consequences of their designs. Thus, the designers should curb their natural optimism and be attentive to unexpected and unwanted consequences. Ulrich Beck, the eminent social scientist, argues that the risk from the uncontrollability in modern society can be prevented by a human effort of risk assessment (Beck, 1992). Accordingly, designers, who deal with ever-updating and ever-evolving systems, have to fully consider the ethical and privacy issues in such a way that unforeseen miss use can be dealt with (Benton, Miller, & Reid, 2018).

Until now, cases of data-mining on people's personal data has led to severe public concerns about their privacy (Gardien et al., 2014). An example is Facebook–Cambridge Analytica data scandal that brought up attention on the needs of having more strict user privacy regulation of tech companies (Meredith, 2018). This scandal has ignited many publics to concern their privacy issues and companies to discuss on their ethical standards. As a result, now companies put a lot emphasis on their concerns on privacy issues; Apple just made their advertisement on their strictness on privacy at the Consumer Electronics Show 2019 (Figure 3) (FEonline, 2019). Therefore, governance becomes an important subject for designers in collective computing, since it helps to structure how users and designers can interact with and share data.

Figure 3. The Advertisement of Apple Products that Taking a Care of Privacy Issues (FEonline, 2019)

As a reaction to this, the European Union implemented the General Data Protection Regulation (GDPR) in 2018 that will guide designers on how to deal with ethical and privacy issues. The regulation will impact designers not only by the way designers conduct their user studies (the user data has to be used only for the purpose that was planned at first, it cannot be analyzed for multiple different purposes), but also as a way of thinking about practical design output that can be implemented within a regulatory framework for data collection and use.

Relationship with a User: Society as Observed Subjects and Design Partners
Designing complex systems —the main design task in era of collective computing— demands designers to include societal understanding in their designs. Consequently, designers have to create a deep understanding of the community they design for. Moreover, community members will actively create parts of the design at the same time. Thus, the community is both the subject of study and a design partner (Ten Bhömer, Tomico, Kleinsmann, Kuusk, & Wensveen, 2013).

6 Discussion and Conclusion

This paper starts with the question: ‘how will future design activities differ from those in current and past eras of modern computing?’ Authors explored this question through literature research on design activities in the PC and ubiquitous computing eras, with the aim to envision the new design activities - design task, design process, and designer- for the upcoming era of collective computing in which multiple people interact with each other through several different computing devices (Abowd, 2016).

The envisioned results are integrating various user data for designing (within or for) complex ongoing-evolving/updating systems at a societal level, having co-exploration and co-evolution design problem-solution spaces, and considering the ethical and privacy issues to prevent the risks from uncontrollability of data collection and processing.

Yet, the framework retains some abstractions that may not fully represent the real world. Therefore, we now have started to conduct expert interviews to validate the presented framework and to obtain additional recommendations and challenges for the collective computing era. Up to the current status, the experts provided further insight about the choice of locations, subjects, and purposes of data collection and analysis, and about working with dedicated communities that can provide constant feedback to designers. The experts also listed some challenges, such as motivating users to share data, and difficulties in identifying

stakeholders in collective computing. As a result, this envisioning design activities is constantly evolving research and this current framework can still become good starting action-points that designers can build on, allowing designers to innovate on their research or design practices for this upcoming computing era for themselves.

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The Career Pathways and Roles of In-house Designers in the Services Sector in Singapore: A Pilot Interview Study

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A growing number of the services sector organisations like banks and hospitals in Singapore are building their own in-house design teams, and as a result, there is an increasing demand for designers to work in these teams. However, there is a lack of career clarity with regards to the job scope, required skills and career pathways for these so-called in-house designers. This paper introduces a pilot study conducted to seek out some missing information from the narrative accounts of practicing in-house designers from different services sector organisations in Singapore. In our findings, the in-house designers can play a greater role in services sector organisations than a "*Form-giving Designer*" that primarily focuses on the styling of products and services. The in-house designers could take on the role of a "*Process Designer*" to facilitate and train other departments and staff within the organisation in design methodologies and practices. They could also play the role of a "*Strategy Designer*" to help the management and other stakeholders to better understand the value of design with measurable data and support the organisation in engaging design as a key organisational strategy. The intent of this paper is to expound on the different roles and career pathways of an in-house designer in the services sectors, as well as identifying some of the skills required for designers to succeed in such roles and career pathways.

Keywords: design; Singapore; services sector; in-house designers; career; skills; education

1 Introduction

The "*Design Integrator*" is an archetype of the role of a designer proposed by the national agency for design in Singapore, the DesignSingapore Council (Dsg). It represents "*designers working in in-house design and innovation teams. They can facilitate organisational innovation. They embed innovation and develop holistic customer experience across business units in the company*" (DesignSingapore Council, 2018). This type of designers, who are more commonly referred as "*in-house designers*", is on the rise in Singapore as more services sector organisations are adopting design as one of their innovation tools and trying to build their in-house design capabilities (Ibrahim, 2017). One such example is the Development Bank of Singapore Limited (DBS). The Managing Director of User Experience & Design, Wongwattanasilpa (2018) explains that "*In 2013, DBS*

engaged a design agency to revamp their internet banking and public website. During the process a few senior leaders in the Consumer Banking Group realized that design is a competitive strength. To keep the momentum going, they decided to build an in-house design team." Similar observations have been made across various types of services sector organisations, such as public services, healthcare services, and food and beverage services.

This trend has been prevailingly observed in the services sector in Singapore, where an in-house design team is relatively new compared to the manufacturing sector. Since 1986, Singapore has moved towards the development of the services sector on top of its mainstream manufacturing sectors (Singapore Economic Development Board, 2011). The importance of the services sector has increased because of two primary factors. Firstly, studies showed that the services sector in Singapore is a more stable source of growth for the economy compared to the manufacturing sector, especially during periods of economic downturn. Secondly, the services sector accounted for the bulk of jobs created in Singapore, and the average wage in the services sectors is higher than those in the manufacturing sector (Monetary Authority of Singapore Economics Department, 1998). The better job opportunities and job stability together with a higher wage also became pull factors for designers to find employment in the services sector instead.

However, services sector organisations in Singapore are still facing difficulties in finding designers to join them, as there is a lack of information with regards to the job scope, required skills and career pathways for these in-house designers in the services sector organisations. The Head of Experience Design in Oversea-Chinese Banking Corporation Limited (OCBC) bank once shared in a local newspaper that, "*When I started in 2010, there was no team. It took a while to build it because it was not a common thing … When you try to find other designers to join a bank, it's very challenging because it's not something on their career path."* (Boon, 2016)

In this paper, we seek to find the missing information through the narrative account of practicing in-house designers from different services sector organisations in Singapore. This paper introduces a pilot interview research that examines the following three questions:

1. What are the career pathways for designers in the services sector in Singapore?
2. What are the skills required for such designers to succeed in their roles?
3. What are the elements that the design schools in Singapore could strengthen to develop more designers for the services sectors?

2 Expert Interviews

The research method selected for this study is an expert interview. Littig (2011) describes an expert interview as "*a semistandardised interview by one or more interviewers with a person identified as a so-called expert and serves to generate data in a research context*", and the experts need to have *"(a) specialist professional or technical knowledge … (b) knowledge of organisational procedures and processes … (c) interpretative and background knowledge ("know-how" and "know-why") in their particular field.*" Five interviews had been conducted in this pilot study. At the point of interviews, the five designers are working in a design team housed within different services sector organisations in Singapore. They are regarded as experts, as they possess the knowledge about the career as an in-house designer as well as the organisational procedures and processes within the services sector in Singapore. All interviewees have working experiences in other types of industries before joining the

services sector, which helps them to articulate their experiences in the services sector organisations in comparison to their previous working experiences. In addition, they have all gone through a minimum of three years of industrial design education and thus possess sufficient background understanding about the design education in Singapore. The five designers are also intentionally selected from different types of services within the services sector to ensure that the data collected are unbiased and not specific to a type of services (as shown in Table 1).

Table 1 Profiles of the expert interviewees.

	Current position	Working experiences	Education
Expert Interviewee 1	An in-house designer in financial services	13 years (about 4 years in the services sector)	Diploma in industrial design (3 years of industrial design education)
Expert Interviewee 2	An in-house designer in public services	7 years (about 4 years in the services sector)	Bachelor's design in industrial design (4 years of industrial design education)
Expert Interviewee 3	An in-house designer in healthcare services	6 years (about 4 years in the services sector)	Bachelor's design in industrial design (4 years of industrial design education)
Expert Interviewee 4	An in-house designer in food & beverage services	11 years (about 2 years in the services sector)	Diploma in industrial design (3 years of industrial design education)
Expert Interviewee 5	An in-house designer in e-commerce services	10 years (about 3 years in the services sector)	Bachelor's design in industrial design (4 years of industrial design education)

The expert interviews were conducted as a semi-structured interview, focusing on the following main questions:

- Can you share more about the scope of works for the in-house design team and how does the team contribute to the organisation?
- How is the career progression for the in-house designer like in your organisation?
- Can you share more specifically with regards to your own job scope in this in-house design team or organisation?
- What skills are critical for an in-house designer career like yours?
- Has your own design education prepared you to work in an organisation like this?
- Do you have any recommendation on how the design education could improve to ensure the graduates are more ready to work in the services sector?

All interviews were conducted face-to-face, one interviewer with one expert each time. Each interview typically lasted around forty-five minutes and was voice-recorded. No body languages or gestures were taken into account. The voice recordings were subsequently transcribed for data analysis. Thematic analysis is selected as the method used for analysing the interview voice recording transcripts. Ayres (2008) describes thematic analysis as "*a data reduction and analysis strategy by which qualitative data are segmented, categorized, summarized, and reconstructed in a way that captures the important concepts*

within the data set. The thematic analysis is primarily a descriptive strategy that facilitates the search for patterns of experience with a qualitative data set; the product of a thematic analysis is a description of those patterns and the overarching design that unites them." We followed the thematic analysis process introduced by Braun and Clarke (2006). The transcribed data were read several times before codes were generated. Any text segment that relates explicitly or implicitly to the research questions was captured. The codes were collated and categorised into themes, which will describe more in detail in the following section.

3 Findings

3.1 Three types of career pathways for in-house designer in different services sector organisations

From the analysis, we found three possible career pathways for designers working in the in-house design team of services sector organisations in Singapore:

1. "*Designer*" career pathway
2. "*Executive*" career pathway
3. "*Trainer*" career pathway

Firstly, there is a "*Designer*" career pathway, where a designer could advance to a senior designer, to a lead designer, and then possibly to a head of design position. Interviewee 1 from a financial services organisation and Interviewee 4 from a food & beverage services organisation shared that this career pathway is very much similar to the career pathway of designers in design firms. Next, there is an "*Executive*" career pathway, where a designer on this career pathway typically starts off as a management executive and will have the opportunity to be promoted to an assistant manager, to a manager, to an assistant director, to a deputy director, and to a director. This career pathway is common in public services and healthcare services organisations. Lastly, there is a "*Trainer*" career pathway for some in-house designers in the financial services and healthcare services organisations. Designers on this career pathway are regarded as trainers, specialists or consultants with the expertise of design methodologies and practices for internal employees and external partners.

The study found that the different types of career pathways in different services sector organisations are mostly due to the existing career progression structure in organisations, and the differences in career pathways do not suggest differences in job scope. For instance, Interviewee 4, who is on the "*Designer*" career pathway, shares a very similar job scope with Interviewee 2, who is on the "*Executive*" career pathway. Project management plays a big part of the job scope for these two interviewees. Furthermore, it is found that in some organisations, for example in the healthcare services, there could have two potential career pathways for the in-house designers: "*Executive*" and "*Trainer*". Interviewee 3 revealed that he started off from a management executive position while his colleague started as a consultant in human factors, even though both of them are in-house designers working in the same healthcare services organisation.

There are also opposing views with regards to the importance of having a title of a designer. For example, Interviewee 3 shared that having a title of a management executive; it dilutes the specialised expertise of designers and blends them with the general administrative roles. This does not help those who want to build their career as a designer. In contrast,

Interviewee 4 appreciates being situated in the "*Executive*" pathway, as it allows him to play a more strategic role instead of being limiting to design projects.

3.2 The different job roles of in-house designers in the organisation's transformation journey

A common theme identified through the interviews is many in-house design teams undergo various transformations in every two to three years. The transformations at times also change the role of the designers. It was observed that the changes are very aligned with "*The Design Ladder*" created by Danish Design Centre (2015). "*The Design Ladder*" highlights four incremental steps of organisation's adoption of design:

- Step 1: Non-design (Design is not applied systematically)
- Step 2: Design as form-giving (Design is used as finish, form-giving or styling in new products or services)
- Step 3: Design as process (Design is an integrated element in development processes)
- Step 4: Design as strategy (Design is a key strategic element in the business model)

Many in-house design teams are initially formed at "*Step 2: Design as form-giving*" and the role of the in-house designers is primarily in designing forms, such as the styling and finish of new products or services. Subsequently, the role of the in-house designers evolves to designing processes and then designing strategies, as the organisation moves up the ladder in the adoption of design. Wongwattanasilpa (2018) adapted the User Experience (UX) Maturity Model by Feijó (2010) to illustrate how his organisation, DBS, has transformed within the four years since the in-house design team was formed:

- Level 1: Unrecognized (UX is 'not important')
- Level 2: Interested (UX is important but receives little funding)
- Level 3: Invested (UX is very important and formalized programs emerge)
- Level 4: Committed (UX is critical and executives are actively involved)
- Level 5: Engaged (UX is one of the core tenets of the organisation's strategy)
- Level 6: Embedded (UX is in the fabric of the organisation; not discussed separately)

In 2014, DBS's in-house design team was formed as the organisation became interested in design (i.e. "*Level 2: Interested*"). The design team comprises of merely two designers back then. In 2018, DBS has transformed and became committed to design (i.e. "*Level 4: Committed*"), and the in-house design team has grown to a size of fifty designers.

We mapped the interview findings around the two aforementioned models. The mapping led us to develop an expanded framework on the organisation' design adoption levels and the roles of the in-house designers (as shown in Table 2). The expanded framework features more levels compared to the UX Maturity Model, as the research revealed that there are more incremental steps. For example, many organisations usually engage the services of design consultancy or design interns before moving from "*Level 1: Unrecognized*" to "*Level 2: Interested*". More importantly, the intent of expanded framework is to explain how the role of in-house designers in the services sector organisation evolves from a "*Form-giving Designer*" to a "*Process Designer*" and then a *"Strategy Designer"* as the organisation moves up the levels of design adoption as described by "*The Design Ladder*".

Table 2 Organisation's design adoption levels and the roles of designers

Level	Design Adoption	Role of designer
1	Awareness (The organisation gets to know about design but remains uncertain to take any course of action.)	
2	Curiosity (The organisation gets curious about design and engages the services of design consultancies or design interns.)	Form-giving Designer
3	Interest (The organisation gets interested in design and forms a small in-house design team.)	
4	Infatuation (The organisation grows fond of design and aspires to expand the design team.)	
5	Connection (The organisation connects the design team with the other department staff.)	Process Designer
6	Enlightenment (The organisation wants formal trainings for other department staff to be knowledgeable about design.)	
7	Commitment (The organisation gets committed to design and desires it to be actively practiced.)	
8	Engagement (The organisation gets serious about design and it becomes a key organisational strategy.)	Strategy Designer
9	Marriage (The organisation gets inseparable with design; design is inherent in the organisation's identity.)	

3.2.1 Job Roles for the "*Form-giving Designer*"

Typically, the in-house design team is formed at "*Level 3: Interest*", after the organisation recognizes the value-added benefits of design after working with a design consultancy or hiring interns from the local design schools. The size of the in-house design team at this level is very small, usually just one to two men. The team can still be working alongside with the design consultancy that the organisation had engaged earlier. The role of the in-house designers at this level mainly focuses on "*form-giving*" (or styling of products and services, according to in '*The Design Ladder*'). For example, Interviewee 1 and 5 shared how their in-house designers are involved in designing the "*look and feel*" of the websites and mobile applications for their respective organisation, while Interviewee 4 shared that his job role used to be more focused on aesthetics of packaging.

According to our interview findings, the design team at the starting stage is also not well funded and not well equipped. In some cases, they do not even have access to professional design software like Adobe Photoshop and Computer-Aided Design (CAD) software like Rhinoceros. They have to utilise common office software like Microsoft PowerPoint instead. This often posts challenges to the in-house designers, as they were not taught how to do design works with common office software during their design education.

After about two to three years, the in-house design team would likely have completed a number of projects and gained significant recognition for their contributions to the organisation. The organisation would want to expand the team then (i.e. "*Level 4:*

Infatuation"). Other than investing more money for new hires, some organisations would bring in other employees or other departments within the organisation, such as data analysts or the marketing department, to join the in-house design team. This is the point that many in-house design teams turn multidisciplinary, and the in-house designers need to learn to work closely with colleagues from other disciplines. For example, Interviewee 4 shared that his in-house design team used to comprise of only designers doing packaging design. This continued until the organisation added the consumer insights team and the sensorial team to form a larger in-house design team. The team was then transformed to comprise of mostly professionals from the science disciplines. Many of the interviewees shared that they did not have prior experience working in a multidisciplinary environment before joining the in-house design team, and they were not trained to work with people of different disciplinary during their days in design schools. Hence they see multidisciplinary collaboration as an important skill from in-house designers.

3.2.2 Job Roles for the "*Process Designer*"

When the multidisciplinary in-house design team becomes more cohesive, the organisation often tasks the team to reach out to engage with the other departments and staffs (i.e. "*Level 5: Connection*"). This is a constructive change for the in-house design team, as the role of the designer begins to shift from a "*Form-giving Designer*" towards a "*Process Designer*". Interviewee 3 revealed that the in-house design team facilitates teams of doctors and nurses in innovation projects to improve quality management. Interviewee 4 shared that besides doing packaging design, the other part of his job scope is to assist in design workshops. His team manager will lead the workshops, while he will assist in sketching the design concepts, as many of workshop participants are from the business discipline and may not know how to draw out the concepts they have come out with. Interviewee 2 also revealed that his team is at the stage of doing both designing and facilitating projects. Facilitation is, therefore, a key skill for the in-house designers to play the role of a "*Process Designer*".

Apart from having facilitation skill, the organisation can progress to take the in-house design team to develop training programs to educate the other departments and staff (i.e. "*Level 6: Enlightenment*"). At the point of the interviews, Interviewee 5 revealed that his team is undergoing this stage of transformation. He expressed that it has been challenging as none within his team has prior experiences in developing training programs. Hence, they have recently hired a former design educator to develop and teach design approaches to the other staff within the e-commerce services organisation. Interviewee 2 and Interviewee 3 also revealed that their teams have engaged former educators from the local design schools to support in this transformation.

3.2.3 Job Roles for the "*Strategy Designer*"

Not many services sector organisations in Singapore have reached "*Level 7: Commitment*", where the organisations are committed to design and desire it to be actively practiced. Even lesser organisations have reached "*Level 8: Engagement*" and "*Level 9: Marriage*", whereby the organisations acknowledge the importance of design and make a deliberate decision to incorporate design into one of their key organisational strategies. This often requires the organisation to include the head of the in-house design team into the organisation's top management team. Interviewee 5 shared that in his previous company, which is a multinational information technology services organisation, the head of his design team sits in the top management meetings. He thinks that this is a very important milestone, as prior to this, the top management would make new organisational strategies first, and thereafter

informs the in-house design team. However, when the head of the in-house design team becomes part of the top management team, he gets to provide input on how design can be applied in the organisation at a strategic level. This is also when the role of designer shift becomes a "*Strategy Designer*".

The study shows that the skills required for the in-house designers in the founding years of the design team are primarily in "*form-giving*". As the in-house design team expands to include professionals from other disciplines, designers will need a "*multidisciplinary collaborative skill*". When the organisation wants a higher level of design adoption, the in-house designers will need to "*facilitate and train*" other departments and staff with design methodologies and practices. Subsequently, when design becomes embedded into the organisation's identity, as a head of the in-house design team, the designer may require skills to "*introduce design at a strategic level*".

4 Discussion

From this research, three roles of the in-house designer are identified. Designers in the Singapore services sector could potentially take on, a "*Form-giving Designer*", a "*Process Designer*", and a *"Strategy Designer*". The "*Form-giving Designer*" refers to designers with a primary job scope in design execution. Brown and Katz (2009) describe this type of in-house designers as "*designers who are skilled technicians, craftsmen, or researchers… They may play a valuable role, but they are destined to live in the downstream world of design execution.*" Even though, the education of "*form-giving*" (the styling of new products and services) helps designers to play a valuable role in the in-house design team as a "*Form-giving Designer*", but it may confine them to the job scope of design execution. The required skills for "*Form-giving Designer*" are what have been conventionally known as design skills, which the design education has focused on. With the emergence of in-house designers in the services sector, we argue that the required skills for a *"Process Designer*" and a *"Strategy Designer*" are areas of consideration for the design education to incorporate in their programmes.

The "*Process Designer*" refers to designers who are able to facilitate and train other departments and staff within the organisation in the design methodologies and practices. Tan (2012) in her doctoral thesis put this type of designers in three categories: "*Designer as Co-creator*", "*Designer as Facilitator*" and "*Design as Capability Builder*". Tan describes, "*The value of the designer as co-creator is where the designer adapts the use of the design process and tools and to permit the participation of people who are not professionally trained in design.*" For "*Designer as Facilitator*", Tan explained that "*Designers can adopt a facilitation role as process experts to lead sessions where a design methodology is appropriate…The importance of the designers leading the process is because design can be unfamiliar and ambiguous process to many partners…"* and "*The designer as capability builder introduces to business the design process and its methods.*" This skill in adapting design processes to facilitate and teach other staffs within the organisation who are not professionally trained in design and unfamiliar with design process is vital for the in-house designers to perform the role of a "*Process Designer*". Napier and Wada (2015) termed this new emerging design skillset as "*design facilitation*", and it refers to "*the ability to develop the mindset, skills and characteristics – along with utilizing processes, process tools, method and planning framework – in order to effectively facilitate others through creative, collaborative problem-solving*."

Napier and Wada (2015) also pointed out that, "*In order to adequately prepare emerging designers to take on this role of design facilitator, design education today must consider a much more holistic approach in preparing students for the complex contests that they will soon find themselves. Design educators today not only need to provide students with working knowledge of design process and tools, they must also build a value-system for participatory, human-centered design, which enables the student to develop the appropriate skills and characteristics necessary for leading others through the design process, utilizing designerly methods and tools.*" Many of the interviewees stated facilitation as an important skill for the job scope of an in-house designer in the services sector. Interviewee 2, who is in the public services sector, put facilitation as the number one required skill. But he questioned why facilitation is not taught in design schools. It could be due to the current design education in Singapore has yet to acknowledge design facilitation as an emerging design skill, and therefore it is not formally taught in the design schools. Or perhaps, like Tan (2010) has pointed out, it could be that even though the role of the designer as facilitator is commonly acknowledged, there is limited literature that elaborates on this role and its practices. Regardless the causes, it is important to note that this design facilitation skill is currently being self-taught on the job, which may have led to the in-house designers feeling inadequate or unprepared for a career as a "*Process Designer*".

Doherty, Wrigley, Matthews and Bucolo (2015) share that there are two stepping-stones that an organisation needs to undergo in order to reach the top level of "*The Design Ladder*" to apply design at a strategic level. They term the first stepping-stone as "*Design as Relationships*", whereby the organisation recognises "*design as a way to create value through meaningful relationships with stakeholders in the business's value chain*" or "*the notion that design could assist customer rapport*". The second stepping-stone is "*Design as Management*" that the organisation understands the value that design can provide from a managerial level and becoming holistically design-led.

Holsten (2011) shares that, "*the ability to collaborate, manage the increasing complexity of design problems, to design 'in context' to their target audiences, and to be accountable for design decisions through measurement transforms designers from 'makers of things' to 'design strategists'.*" He highlights that designers need to know how to use business tools, like competitive and situational analysis, to help them better understand the business environment in order to develop more strategic solutions. He also emphasise about designers being able to communicate the value of design, especially in terms the return on investment like sales number or customer satisfaction. As none of the in-house designers in the expert interviews is currently playing the role of a "*Strategy Designer*", so their inputs are based their perspective of the job scope and required skills of their head of design team. However, together with the literature findings, a common theme is identified that a "*Strategy Designer*" will need the ability to communicate the value of design with measurable data to the organisation management and other key stakeholders, in order to bring design to be applied at a strategic level.

5 Conclusion and further research

This research is only a pilot study based on a limited amount of data drawn from the interviews with five in-house designers working in the Singapore Services Sectors. Further work needs to be conducted to identify more potential career pathways, jobs roles and skills

required for in-house designers in the services sectors through a more in-depth research study with a bigger pool of interviewees.

The pilot interview study shows that the skills required of the designers working in the services sector are definitely not confined to design execution as a "*Form-giving Designer*". Further conversations with design educators on the emerging design skills, such as design facilitation skill for a "*Process Designer*" and the ability to communicate the value of design with data for a "*Strategy* Designer", could lead to a better understanding and exploration on its implications to the design education as well.

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The Changes of Tourism Cultural and Creative Products in the Future: A Study on the Consumer Preference of Intangible Cultural Heritage Products—Taking “Tujia Brocade” as an Example

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“Tujia Brocade”, the traditional crafts of China, is the Chinese people's wisdom for thousands of years, which shows the creativity and intelligence of the people. The tourism industry in Tujia has been developed rapidly but the tourism cultural and creative products have been not very rich and the consumer aesthetic demand have not received adequate emphasis. The existing research findings were mainly the record of “Tujia Brocade” and the related design applications of “Tujia Brocade”. The research about the preference for textures of “Tujia Brocade” has been still rare. This study made research on the relationship between the consumer imagery and preference of different types of “Tujia Brocade” patterns and the factors of gender, residence and design background. The research questionnaire was designed base on 20 vocabularies and 9 representative samples of “Tujia Brocade” patterns. After the collection of 59 questionnaires, the independent T-test and the one-way ANOVA was used to analyze. The research results reveal that the factor of gender and the factor of residence have great difference for the consumer preference on “Tujia brocade” patterns. The factors of gender, residence, education background and design background will influence the imagery of “Tujia brocade" patterns, of which the factor of design background has significant influences. In conclusion, the consumer imagery and preference analysis of “Tujia brocade” may help merchants understand the consumer psychology. The aesthetic demands of consumers can be widely considered. The sharp insight and deep understanding of consumers may also help “Tujia brocade” products expand consumer market and improve market competitiveness. The changes of traditional “Tujia brocade” industry can also be refreshed and the market prospects may be broad.

Keywords: Tujia brocade; imagery; preference; tourism products changes; independent T-test; one-way ANOVA

1. Introduction

Chinese traditional cultural has a long history. Every nation has its own representative traditional handicraft skill, carrying the life history and culture. "Tujia brocade" is one of the four famous brocades in China, and it is also known as "Xilankapu". It has a venerable history dating back more than a thousand years. "Tujia brocade" incarnates ancient folk art’s exquisite skills and embodies the wisdom and diligence of local people. "Tujia brocade" passes on Tujia culture with national features, and it has been the precious and valuable spirit

strength in Chinese traditional culture. In 2005, "Tujia brocade" was included in the national protection lists of non-material cultural heritage, so that it can be better pass on and carry forward the excellent Chinese traditional culture. "Tujia brocade" was selected as the research object. The consumer preference of it also were investigated. The study aims to assist designers, artists and manufacturers to design "Tujia brocade" tourism cultural and creative products and alternatives. The analysis of consumer preference may bring changes to traditional “Tujia brocade” tourism product industry, and it help traditional crafts try to walk out of predicament.

1.1. The origin of “Tujia brocade”

Tujia nationality has a long history, located in Hunan, Hubei, Chongqing and Guizhou. The ancient civilization of Bachu gave birth to Tujia culture. It continuously learned from other ethnic groups during the long-term development process. "Tujia Brocade" is one of the most representative cultural crystallization, which displays the landscape, customs, religion. The history of "Tujia Brocade" is rich and colorful, which is a perfect combination of practicability and artistry. Moreover, it also plays an important role in religious ritual. The local people called "Tujia Brocade" as "Xilan Kapu”. "Xilan" means quilt and "Kapu" means flowers. When Tujia women married, "Tujia Brocade" would be a part of her dowry. The quantity and quality of "Tujia Brocade" often highlighted her status in their families and also reflected the economic strength of their families. It is said that "Tujia Brocade" has a thousand-year history. The origin of "Tujia Brocade" can be traced back to the culture of Bachu. At that time, the people were good at weaving and agriculture production. Some "Tujia Brocade" patterns significantly influenced by the totem culture, such as "Taitai tiger" and "Snake flower" (Figure1).

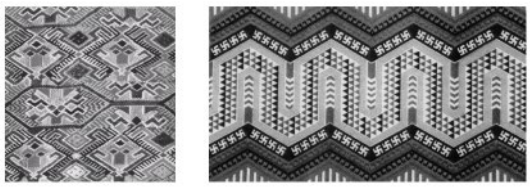


Figure 1. Images side by side showing the Taitai tiger pattern (left) and the Snake flower pattern(right). Source: Sirankap's descendant: Tujia brocade masters and inheritor oral history

It can be seen from the origin of "Big geometric pattern" and "Dragon and phoenix pattern" (Figure 2) which were unearthed in Chu kingdom is based on Bachu culture.

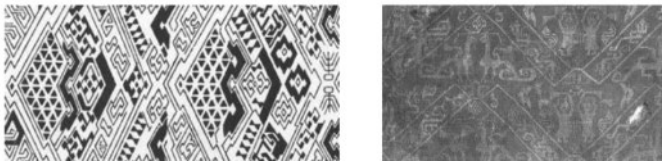


Figure 2. Images side by side showing the Big geometric pattern (left) and the Dragon and phoenix pattern (right). Source: Sirankap's descendant: Tujia brocade masters and inheritor oral history

Since the Qin and Han dynasties, the brocade industry in Tujia area had developed gradually. During the three kingdoms period, Zhuge Liang who was an outstanding statesman and strategist strongly supported brocade development to bring enormous profits for the country. During the Tang and Song dynasties, the economic exchange of Tujia was increased

greatly. The economic exchange promoted the brocade industry in Tujia area to have a further development. In the Yuan, Ming, Qing dynasty, "Tujia Brocade" were known as "Tu Jing" or "Hua Bu", and it widely used in clothing. After the bureaucratization of the Qing dynasty, the weaving skills were further improved.

1.2. The characteristics of "Tujia brocade"

"Tujia brocade" needed cotton twine warp direction yarns interwoven with dyed weft direction yarns using wood shuttles and bamboo buckles. Before the bureaucratization, "Tujia brocade" had been primarily used for common clothing, accessories, backpacks, panniers and embroidered purses. It also could be used as bedspreads, curtains, tablecloths, cushions, towels, table mats and so on. On top of many useful functions, "Tujia brocade" may also be used in religious ceremonies.

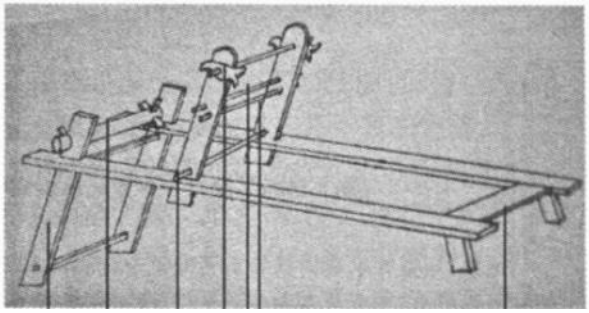


Figure 3. A wooden twill weaving machine.
Source: Sirankap's descendant: Tujia brocade masters and inheritor oral history

In addition, young people often use "Tujia brocade" as the token to show their love. "Tujia brocade" needed a wooden twill weaving machine (Figure 3). This loom almost the same as the loom in the Han dynasty in structure and cross-stitch method. The twill weaving machine was about 1.5 meters long, 0.7 meters wide, about 1 meter high, mainly including rack, roller plate, palm stick, tread stick, reed, thoreau, crown daisy, holding pole, linkwork, roller bar, ligature, interlocking bar, and quantizer(Cheng, Yang, Jiang, & Hu, 2019).

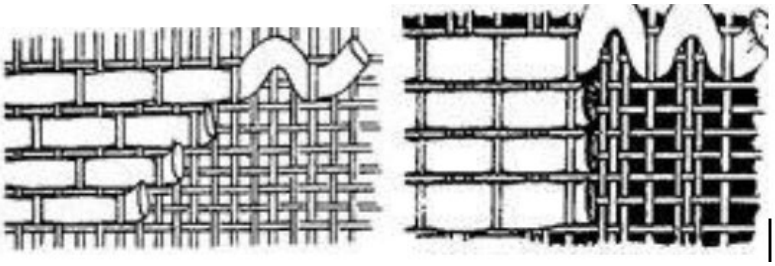


Figure 4. Images side by side showing the plain weave (left) and the twill weave (right).

Source: Research on the Art Symbol of Tujia Brocade

The rolling plate was used to wind warp and the heald bar will pull weaving warp in the weaving process. This machine can be controlled to weave plain fabrics and twill fabrics (Figure 4). The weaving technology of "Tujia brocade" was the crystallization of the wisdom of Tujia people. The patterns of it express the feelings of the Tujia weavers. The whole process was complicated and rigorous. It needed persistence and perseverance according to the details of the patterns, otherwise errors may occur.

The number of "Tujia brocade" patterns were quite abundant. Common traditional patterns were nearly 120 species, but there were approximately 80 kinds of traditional patterns can be woven currently. Types of "Tujia brocade" mainly included "Animal-themed type", "Plant-themed type", " Living appliances-themed type ", "Custom- and tradition-themed type", "Geometric-themed type" and "Modern-themed type". These themes were all connected to local living environment. "Tujia brocade" reflected Tujia people's love and understanding for life. "Tujia brocade" patterns had many characteristics, including abstraction and abundance. The characteristic of abstractness was the main feature of "Tujia brocade" patterns. The local honest folkway of Tujia people and unusual stitch has a tremendous effect on the expression ways of patterns. The curves of "Tujia brocade" patterns were replaced by step-like lines. Everything in the natural world could be woven into "Tujia brocade" by Tujia weavers through changing smooth curves into step-like lines. Some "Tujia brocade" were composed of repeating base patterns, and some patterns included separate patterns only. "Tujia brocade" were influenced by Pakistan culture in early days, and then continued to absorb a variety of culture. Finally, "Tujia brocade" owned abundant elements, from daily life to astronomical phenomena.

1.3. The development predicament of "Tujia brocade"

"Tujia brocade" had excellent art accomplishment and represented distinctive features which can carry forward the national cultural and spirit deeply. If "Tujia brocade" patterns were applied to modern design, both sides would reach a win-win situation (Han & Han, 2015). As results of social development, cultural ecology revolution and values change, "Tujia brocade" gradually lost edge and got hit by foreign culture and mechanized production (Li & Zhu, 2016). In the past, the process of Chinese folk culture had three damaging shocks. The first shock was democratic reforms and socialist transformation around 1950. The second shock was the cultural evolution, and it bring a devastating blow to traditional culture. The third time because of modernized wave in the late 1980s (Huang, 2006). The problems in the development of "Tujia brocade" could be summarized as the following:

- The aging situation of craftsmen has been increasingly prominent and a lot of young people migrated to the city to work, the technique of "Tujia brocade" gradually fell into disuse and its rich language of art has been neglected.
- "Tujia brocade" products has become more and more homogeneous seriously in recent years. Most products on the market were still simple copy of traditional patterns, lacking of culture, aesthetics and novelty. It was hard for "Tujia brocade" products into the common life of the public. Some "Tujia brocade" products were made by experienced masters which could be long-term running, inefficient, expensive and small output, and these products could not meet the needs of consumers.
- The public has not been famous with the culture of "Tujia brocade". It originated from western human and has limited influence. Many features arts and culture characteristics of "Tujia brocade" has been somewhat unfulfilled. Furthermore, facing influx of foreign culture, the public’s awareness and values tended to be recreational and consumptive. They were difficult to discern the intention behind patterns. "Tujia brocade" has been faced challenges of survival and development, it had to confront market and competition mechanism, figuring out its own business model and capturing consumer psychology (Li & Zhu, 2016).

1.4. The organization form of “Tujia brocade” patterns

After thousands of years of development, "Tujia brocade" continued to inherit and carry forward, and formed the more mature artistic organization(Hong, 2018). The organizations of the "Tujia brocade" patterns can be summarized into 16 kinds of basic frameworks (Figure 5). It is common to repeat basic shapes in accordance with the needs of the overall image in the frame line (Hu, 2008).

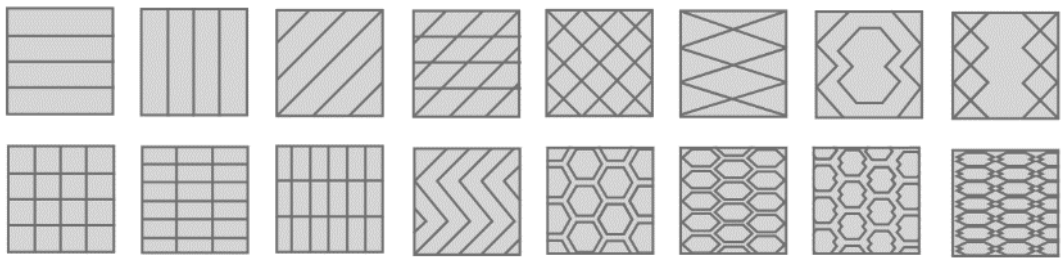


Figure 5. 16 kinds of basic frameworks of “Tujia brocade” patterns.
Source: Research on the Art Symbol of Tujia Brocade

1.5. The tourism cultural and creative products industry of “Tujia brocade”

“Tujia brocade” has significance and there is a compact relationship between “Tujia brocade” and regional tourism development. The development of tourism cultural and creative products are the significant strategic resources in tourism industry. The development of tourism products and “Tujia brocade” combined to increase the income of the ethnic areas, which is a win-win situation for both cultural and economic development. The tourism products may absorb more Chinese traditional cultural elements and the mutual understanding and cultural communication may be promoted. However, the tourism products come with some problems during the rapid development of tourism industry. The local selling products have high homogeneity, and the old style does not meet the aesthetic needs of consumers, so that many consumers are not willing to buy these existing “Tujia brocade” tourism products in the market (Shi & Zhang, 2018).

In the past, researches have focused on the cultural protection of “Tujia brocade”. Many local customs have been recorded, and the development of “Tujia brocade” were traced from ancient times until today by many researchers. The reasons for the differences of the patterns, production sites and designs of “Tujia brocade” (Huang, 2005). Some researchers protect the copyright of “Tujia brocade” by combining modern digital technology (Jun, 2011).

In recent years, the studies focus on the application of “Tujia brocade” on the basis of the existing records of the technology. The cultural elements of “Tujia brocade” were combined to the virtual human characters shaping in computer animation to help broadcast and develop the culture of “Tujia brocade”(Zhao, 2017). The elements of patterns have strong national intension and local characteristics also were applied in the home stay interior design (Zeng & Zhang, 2018). The structure and color of “Tujia brocade” were also interpreted, so that these understanding can be used in modern packaging design and “Tujia brocade” can be widely recognized(Zheng, 2018). Many other studies try to combine traditional elements of “Tujia brocade” into landscape design, advertising design, furniture design and other aspects.

Integrating traditional culture with everyday life is of great significance, so that people may be closer to the precious traditional culture of “Tujia brocade”. However, if the data of consumers’ preference can be collected before commercialization, the commodity orientation that conform to the specific crowds may improve the core competitiveness of “Tujia brocade” tourism products.

In this study, the questionnaire survey, the focus group, T-test and one-way ANOVA were used to analyze the differences in subjects' preferences for the patterns of “Tujia brocade” on the basis of the gender factor, design background factor and the residence factor. These study can provide reference for relevant manufacturers and designers to design more directional and stylish tourism products of “Tujia brocade” to quickly open market channel. Questionnaires were collected to investigate the preferences of different types of consumers for “Tujia brocade”, so that customer's requirements at different levels can be satisfied.

2. Methods

2.1. Questionnaire Survey

Questionnaire survey is a method used by researchers to collect information. It is usually adapted to measure personal behavior and attitude. The tool of questionnaire survey are questionnaires which is the key element to understand the nature of the problem or to solve the problem, in particular for the measurement of structural variables. The researcher need to set questions into questionnaires, answering by mailing, answering online, answering in person and follow-up visiting to understand the subject's opinions on a phenomenon or question. The principles of designing questionnaires are as follow:

The question could be fully understood and not exceed the knowledge and ability of the interviewees; the questions need to meet the needs of study hypothesis and it can be able to trigger the true reflection of the respondents; Questions cannot vague, too broad, or include two or more concepts that easily lead to misunderstanding; Questions cannot involve social taboos and sensitive issues; The problems cannot produce a hint; Questions should be easy to record faithfully and analysis data, including coding and typing questionnaire data.

2.2. Likert Scale Survey

The Likert Scale created by psychologist Rensis Likert. The Likert scale is a psychological measurement scale commonly used for questionnaires. It is usually used to measure the subjective or objective judgment of a subject for a description which is describe the degree of agreement or disagreement.

The typical Likert scale survey divides the subjects' judgments into five categories: strongly disagree, disagree, no opinion, agree, and strongly agree. Some researchers will use more detailed assessment degrees, such as: seven or nine degrees of measurement. In addition, some researchers could force subjects to decide from two different tendencies (such as: satisfied, not satisfied). In general, the preparation of the Likert scale is as follows:

1. Draw up the statements associated with the attitude. These statements should reflect the positive and negative attitude of the individual (agree or disagree), and each statement should be measured by same level (five, seven, or nine levels).
2. According to of the tendency of the statement give different scores. For positive statements, the answer is more positive, the score of answer is higher. For negative statements, the answer is more negative, the score of answer is higher.

3. Select a number of respondents to join in the pretest. Researchers must pay attention to whether the statements in pretest are discriminative. If the subject gives the same answer to each question, the scale could not distinguish the difference.
4. Researchers can obtain the scores of these respondents and translate the answers of each statement into scores to understand subjects' attitudes. The Likert scale survey is easy to understand and convenient to use which become the most popular and most widely used scale in quantitative research.

2.3. Focus Group

The focus group was developed by Merton who was an expert of the institute of Applied Social Studies in Columbia University to analyze the ratings of radio programs in the 1940s. The audiences express the degree of affection for the show by the red, green two different buttons connected to the radio. Afterwards, advertising and marketing often use focus groups to investigate consumers' responses to product packaging.

In the focus group, six to twelve participants need to have free and interactive discussions on particular topics to collect in-depth and authentic opinions and ideas. This method has a variety of functions. when the research information is insufficient, the focus group method can be used to collect the opinions of the relevant personnel and help researchers clarify the possible research direction. In addition, researchers can correct the structure and content of questionnaires through focus group method to improve the relevance of the questionnaires.

If the results of analyzing survey data collected are inconsistent or unexplained, the possible answers can be made through focus group method. Finally, the focus group method can also be used to verify whether the findings are correct. If the results of the discussion are found to be in conflict with the finding which means it is necessary to re- examine the study. The focus group method must go through three stages of planning, discussion, analyzing.

There are three focal points during the planning phase. Firstly, it is appropriate to design less than six problems according to the purpose of the study. Secondly, the more extensive the research topic involved, the greater the number of group focus meetings. Thirdly, the focus group members had better have relevant knowledge or experience. Attention should be paid during the discussion stage. The host, recorder and assistant personnel should be indispensable. In addition to the traditional notes during recording, the recorder can use the tape recorder, camera and other auxiliary equipment. The focus group method has the characteristics of rapid collection of information which requires a small number of subjects and can access to in-depth information. Therefore, it is worthy for researchers considering to use.

2.4. One-way ANOVA

The One-way ANOVA analysis is a special form of statistical hypothesis which is proposed by R. A. Fisher. It can verify the significant of two or more samples at the same time, and thus are widely used in the analysis of experimental data. If the statistical results are significant (when the probability of p is less than the critical "significant value"), the null hypothesis can be reversed.

Statistical analysis hypothesis of variance analysis usually showed difference according to different models. However, broadly speaking, the variance analysis has a total of three assumptions:

- The group distribution behind each group of samples must be either a normal distribution or a normal distribution.
- Each group of samples must be independent.
- The number of variants of groups must be equal.

When the variance analysis results show statistically significant, it means that the average of the reaction variables is different from the given factors. Thus, the post-hoc test should be used to further explore the reasons for the average difference of the reaction variables. In the proceeding of development in post-hoc test statistics, there are a number of distinctive methods and still some new methods have been published. But the essence of computing are similar, amending the rise of the first type of error because of multiple comparison.

The more commonly used method are Bonferroni, Tukey, Duncan and Scheffé, and the remaining methods are listed below : Bonferroni T tests, Tukey's range test, Duncan's new multiple range test, Dunnett's two-tailed test, Dunnett's one-tailed test, Gabriel's multiple-comparison procedure, Levene's test, Waller-Duncan test, Ryan-Einot- Gabriel-Welsch multiple range test, Scheffé's multiple-comparison procedure, Student- Newman-Keuls multiple range test, Fisher's least-significant-difference test and Waller- Duncan K-ratio T test.

3. Results

A total of 67 “Tujia brocade” patterns were collected through the literature review, and these patterns were processed using different filters by Adobe Photoshop CS6 and converted to black and white. Six designers with more than three years of design experience were invited to classify the samples according to the “Tujia brocade” pattern organization (Figure 6). First, the 8 invalid samples from samples were removed. These invalid samples include repeated patterns and cannot be clearly distinguished patterns.

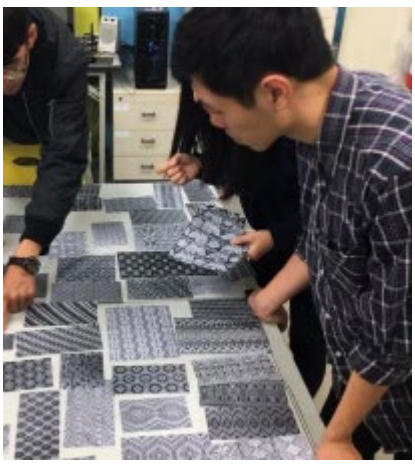
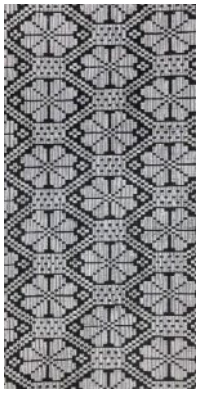


Figure 6. The scene of classifying the samples.

The remaining 59 samples were divided into nine types of patterns. There are the angle-missed hexagonal basic type pattern, the regular hexagonal basic type pattern, the rhombic basic type pattern, the organic basic type pattern, the totemic basic type pattern, the flat hexagonal basic type pattern, the polyhedral hexagonal basic type pattern, the regular octagonal basic type pattern and the continuous geometric basic type pattern.

Table 1 This is the nine samples

Sample one	Sample two	Sample three	Sample four	Sample five
The angle-missed hexagonal basic type pattern	The regular hexagonal basic type pattern	The rhombic basic type pattern	The organic basic type pattern	The totemic basic type pattern
				
Sample six	Sample seven	Sample eight	Sample nine	
The flat hexagonal basic type pattern	The polyhedral hexagonal basic type pattern	The regular octagonal basic type pattern	The continuous geometric basic type pattern	
				

Six designers with more than three years of design experience were invited to select the most representative sample of each category through the focus group. A total of nine samples were selected (Table 1). 147 adjectives describing "Tujia brocade" patterns were collected through literature and books. Then 20 vocabularies are chosen through the focus group. These vocabularies were used in the design of questionnaires (Table 2).

Table 2 This is the table of 20 vocabularies

1. regional--public	2. continuous--interruptible
3. traditional--contemporary	4. geometric—curvilinear
5. serious--lively	6. regular—wild

1. regional--public	2. continuous--interruptible
7. decorative--simple	8. free--constrained
9. complex--concise	10. abundant--single
11. elegant--heroic	12. quiet--fretful
13. balanced--unbalanced	14. mysterious--open
15. unique--ordinary	16. soft--masculine
17. dedicate--rough	18. religious--secular
19. metaphorical--distinct	20. aesthetic--ugly

The questionnaires can be divided into two stages. In the first stage, participants needed to fill in the basic data, including gender, age, place of residence, educational background, whether own the design background. In the second phase, subjects were required to choose the imagery and preference degree of 20 pairs of adjective vocabularies to nine "Tujia brocade" samples they considered according to seven-point Likert scale. The evaluation scale is divided into seven points respectively. Taking regional--public as an example, the closer the imagery of a "Tujia brocade" sample is to regional, the lower points the sample get. Reversely, the closer the imagery of a "Tujia brocade" sample is to public, the higher points the sample achieve and there is no obvious bias if the scores of subjects are near four points.

The scale of the preference score has strongly dislike, a little dislike, in general, a little like and like. The scale can be converted into seven-point level, which are 1-point, 2-point, 3-point, 4-point, 5-point, 6-point and 7-point respectively. Therefore, 1-point, 2-point and 3-point mean that the preference of the sample may be biased towards dislike. The intensity of 1-point is greater than 2-point. The intensity of 2-point is greater than 3-point. On the contrary, 5-point, 6-point and 7-point represent the preference of subjects could be partial to like. The total number of valid questionnaires were 54. Figure 7 shows the overall distribution of the subjects.

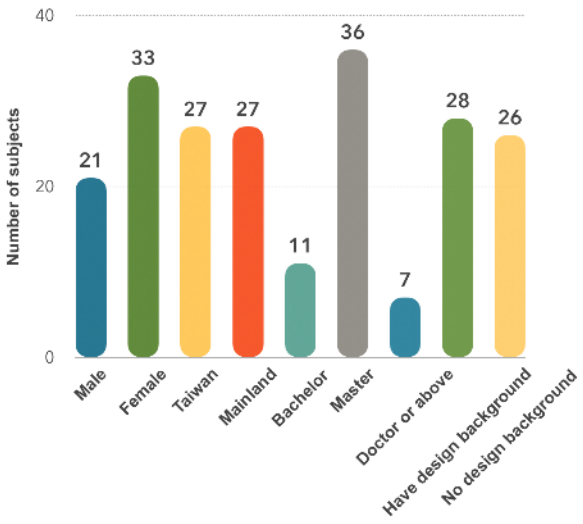


Figure 7. The overall distribution of the subjects.

A total of 27 subjects come from Taiwan and the others come from Chinese mainland. There

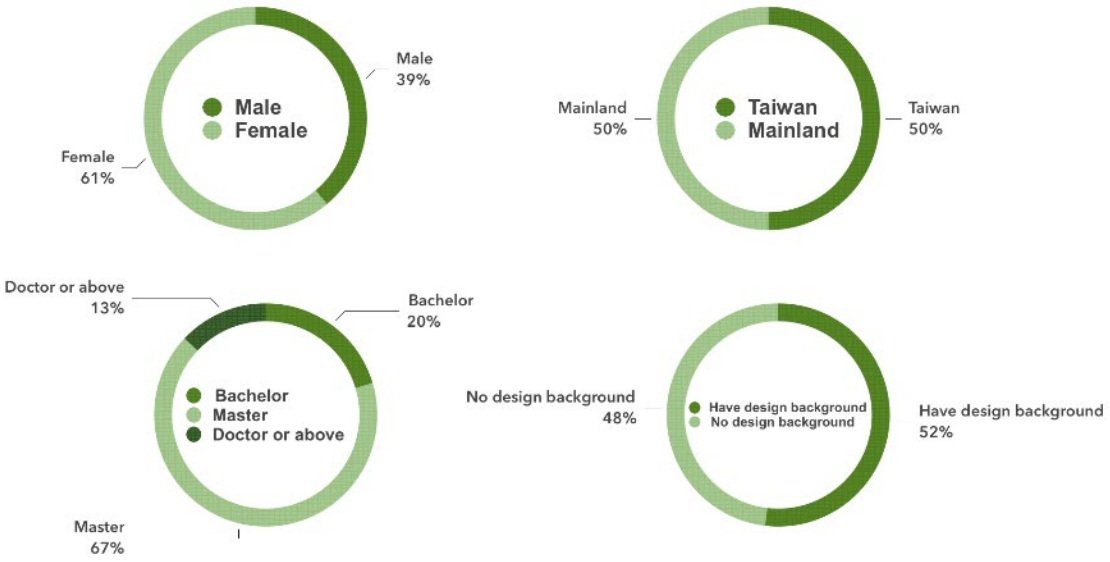


Figure 8. The distribution of gender, residence, education background and design background.

are 11 undergraduate students, 36 graduate students and 7 doctoral students submitted the questionnaires. These subjects include 28 designers and 26 people with no design background (Figure 8).

The study conducted mainly based on SPSS 10 statistical software. The imagery and preference degree of "Tujia brocade" samples in 20 pairs adjective vocabularies were analyzed according to independent t-test and one-way ANOVA (Figure 9).

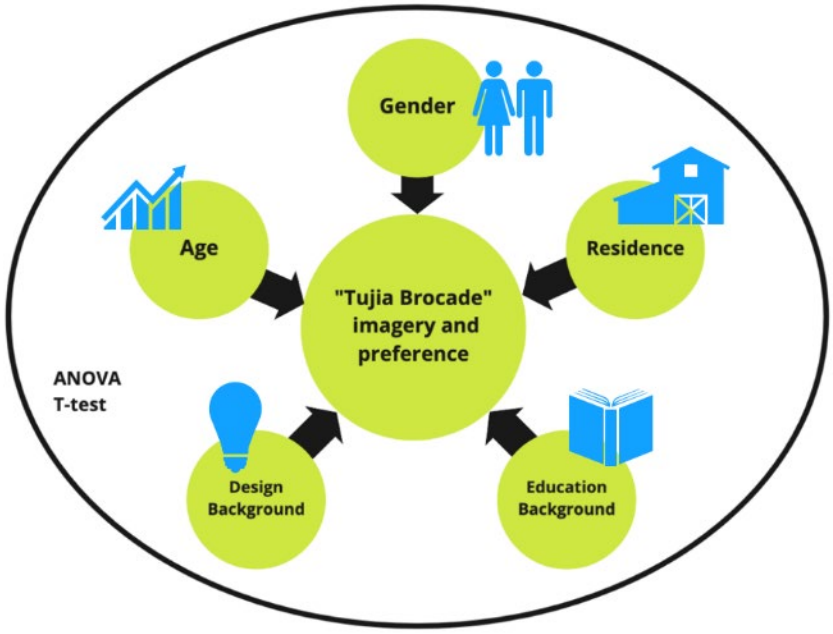


Figure 9. The research framework.

3.1. The influence of the gender factor on the imagery of "Tujia brocade" patterns

The study examined the differences of the factor of gender on the imagery of "Tujia brocade" patterns through the independent t-test. The research took $p < 0.05$ as a significant standard. There were 21 males and 33 females of all 54 subjects.

Three groups of vocabularies had significant differences, respectively were the vocabulary groups “complex—concise” and “aesthetic—ugly" of sample three and the vocabulary group “geometric—curvilinear" of sample seven. The different genders had small difference in the imagery of other vocabulary groups .

Taking the sample three as an example, there was significant difference between male and female subjects in the imagery of “complex” and “concise”. The significance of the variance test is $p = .004 < .05$(Table 3). It found that men were more likely to think that sample three was bias towards “concise” and “aesthetic” than women. For sample seven, women were more tend to the imagery of “curvilinear” than men.

Table 3 This is the result of independent t-test.

	Vocabulary		F	Significant	t	df	p	Mean difference	Standard error difference	Lower bound	Upper bound
	Complete — Concise	Assume equal variance	9.159	0.004	1.82	52	0.074	0.89177	0.4899	-0.09129	1.87484
		Do not assume equal variance			2.065	50.807	0.044	0.89177	0.43185	0.02472	1.75883
	Male										1.27
	Female										0.44
	Aesthetic —	Assume equal variance	0.125	0.725	-2.102	52	0.04	-0.71861	0.34181	-1.4045	-0.03273

	Ugly	Do not assume equal variance			-2.086	41.66	0.043	-0.71861	0.34442	-1.41385	-0.02338
	Male										-0.86
	Female										-0.15
	Geometric — Curvilinear	Assume equal variance	12.055	0.001	2.856	52	0.006	1.21212	0.42437	0.36055	2.06369
		Do not assume equal variance			2.596	30.467	0.014	1.21212	0.46692	0.25916	2.16508
	Male										-0.55
	Female										-1.79

3.2. The influence of the gender factor on the preference of "Tujia brocade"

The study investigated the effect of gender factor on the preferences of "Tujia brocade" by independent t-test. The results showed that the imagery of sample three and sample nine had significant differences for the the gender factor. Male subjects were more likely to have a tendency to choose concise and powerful patterns, and female subjects may prefer soft and decorative patterns. The significance of sample three ($p=0.021 <.05$) and sample nine ($p=.023<.05$)(Table 4). The imagery of both samples were all biased towards the following vocabularies: public, continuous, geometric, regular, concise, single, quiet, balanced, open, ordinary, masculine, secular, distinct and aesthetic. Male subjects may have more affection to patterns with the above adjective characteristics.

Table 4 This is the result of independent t-test.

		Levene test								
									95% confidence interval	
		F	Significant	t	df	p	Mean difference	Standard error difference	Lower bound	Upper bound
Sample 3 preference	Assume equal variance	0.845	0.362	2.382	52	0.021	0.89177	0.37431	-0.09129	1.87484
	Do not assume equal variance			2.446	46.353	0.018	0.89177	0.36459	0.15805	1.62550
	Male	0.68								
	Female	-0.24								
Sample 9 preference	Assume equal variance	1.123	0.294	2.343	52	0.023	0.97403	0.41571	0.13984	1.80821
	Do not assume equal variance			2.453	48.738	0.018	0.97403	0.3971	0.17591	1.77214
	Male	-0.86								
	Female	-0.15								

3.3. The influence of the residence factor on the preference of "Tujia brocade"

The results showed that the preference significance of the sample two was 0.018(Table 5). The sample two contained the traditional pattern called "cat footprints". Because the Tujia people have the worship to white tiger since the ancient times. The white tiger can determine who lives and who dies and it also could punish the wicked, so that the white tiger has been the god of brave in Tujia people's minds until now. The pattern of “cat footprints" was the simplification of the white tiger. If some subjects had a certain understanding of its culture, their preferences could be influenced.

Table 5 This is the result of one-way ANOVA.

		Levene test								
									95% confidence interval	
		F	Significant	t	df	p	Mean difference	Standard error difference	Lower bound	Upper bound
Sample 2 preference	Assume equal variance	0.129	0.721	-2.439	52	0.018	-0.74074	0.30368	-1.35012	-0.13136
	Do not assume equal variance			-2.439	51.856	0.018	-0.74074	0.30368	-1.35017	-0.13132
	Male									0.91
	Female									0.74

4. Discussion

4.1. The influence of the gender factor on the imagery of "Tujia brocade"

There were 21 males and 33 females of all 54 subjects. The image of three groups of vocabulary had significant differences(“complex—concise” and “aesthetic—ugly” of sample three; the vocabulary group “geometric—curvilinear" of sample seven). It found that men were more likely to think sample three was bias towards concise and aesthetic than women. And for sample seven, women were tend to the imagery of curvilinear. The internal of sample three appears repeated smaller rhombuses, obvious color contrast and twill arrangement. From females' sensitive and dedicate point of view, more details of the patterns would be observed. Female subjects may mostly focus on the internal repeated floral elements of sample seven and male subjects could pay more attention to the overall feelings.

4.2. The influence of the gender factor on the preference of "Tujia brocade"

Male subjects were more likely to have a tendency to concise and powerful patterns, and female subjects may prefer soft and decorative patterns. The imagery of sample three and sample nine were all biased towards the following vocabularies: public, continuous, geometric, regular, concise, single, quiet, balanced, open, ordinary, masculine, secular, distinct and aesthetic. Male subjects may have more affection to patterns with the above adjective characteristics.

4.3. The influence of the residence factor on the preference of "Tujia brocade"

This study explored the influence of the residence factor on the preferences of "Tujia brocade" patterns. The results showed that the significance of the sample two was 0.18. If some subjects had a certain understanding of its culture, their preferences could be influenced.

The study focused on providing designers and sellers with reference, so that the designers, artists and manufacturers to have a better understanding of consumer psychology and to increase connection between designers and market. Then “Tujia brocade” will improve the market competitiveness and complete the transformation of traditional industries.

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The Evolving Landscape of Design Research in the UK

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This paper reports on the evolving landscape of design research in the UK over the last 12 years. Through a rigorous analysis of a sample of 379 design research projects funded by the Arts and Humanities Research Council (AHRC), this paper presents a detailed account of the evolution of AHRC-funded design research and how various factors – such as the financial value, project team size, collaborating organisations, and the geographical spread of design research in the UK – has changed in the period between 2002 and 2018. The paper examines the nature, scale, and diversity of UK-based design research and how it is increasingly interdisciplinary and collaborative. Furthermore, it shows the extent to which design researchers are dealing with significant social, cultural, economic, and environmental issues including those articulated in the United Nations (UN) Sustainable Development Goals (SDGs). Furthermore, whilst highlighting issues overlooked in contemporary forms of design research in the UK, the paper suggests other possible challenges for design research to focus on in the future in order to strengthen its contribution to activating social, cultural, economic and environmental change.

Keywords: design research; evolution; change; UN Sustainable Development Goals

1 Introduction

A feature of the design research landscape is that it is constantly evolving as researchers, collaborators, and project partner organisations respond to address social, environmental, cultural, economic, and other challenges. Similarly, the boundaries of the discipline are evolving from design subjects focused on various forms of the material world – such as products, interiors, fashion, and graphics – towards other less tangible domains, such as service, interaction and transformation design (Cooper, 2014). Alongside an increase of its depth in supporting innovation or industrial competitiveness, design research is also widening its breadth as it contributes new knowledge in a range of fields, such as social innovation, policy design, and healthcare. We are also witnessing changes in the design research process, which used to be driven by individual designers or teams of designers and is now increasingly led by interdisciplinary teams and also includes end-users and others involved in co-design processes. The growth of design research globally is evidenced by the upsurge of international design conferences, organised by the likes of the International Association of Societies of Design Research (IASDR), the Design Research Society (DRS), and the European Design Academy (EAD). As Cooper (2016) notes, the level of detail, rigour, and development of design research has risen over time, as well as the amount of funding available for design researchers, at least in the UK and Europe. This has also

contributed to the substantial increase in the number of design PhD students in the UK and globally. The development of a more robust and outward-looking design culture has also seen the employment of research active design staff across higher education institutions and a range of advanced design research centres and teams, addressing complex challenges in areas such as climate change, health and wellbeing, and policies that benefit wider society.

2 The UK Design Research Landscape: A Brief History

As part of the first author's on-going Arts and Humanities Research Council (AHRC) Design Leadership Fellowship, this paper explores the landscape of design research in the UK. Design education in this country can trace its roots back to the 1830s when art and design schools were established throughout the UK to train future generations of professionals to work in manufacturing and other industries (Press, 2011). Over the last 50 to 60 years, design research in the UK has undergone three main intellectual waves (Rodgers and Yee, 2016). The 1960s marked the 'Design Science' era where researchers largely adopted a scientific approach to studying design methods (Hubka and Eder, 1996) and contributed to what Rittel (1972) called the 'first generation design methods'. This early phase of design research aimed at incorporating scientific methods and knowledge into the design process in order to optimise decisions (Bayazit, 2004). Two of the leading British design researchers of the time, Bruce Archer and John Chris Jones, were part of the organising committee of the formative Conference on Design Methods held at Imperial College in London in 1962. Archer later went on to establish the Industrial Design Research Unit at the Royal College of Art, which is seen as a milestone in the history of UK design research. The second wave arose in the 1970s as a reaction to the first-generation design methods movement, being criticised as simplistic and not able to tackle the complexity of real-world problems, defined by Rittel (1972) as 'wicked'. The foundations of the Design Research Society (DRS) in 1976 widened debates on establishing design as a discipline in its own right. In the third and current wave, design is fully recognised as a discipline distinct from both the arts and the sciences. From this perspective, Cross (2006) articulated the "designerly ways of knowing, thinking and acting" that clearly contribute to the development of a design culture, while also acknowledging the contributions to and from other disciplines.

The establishment of the Research Assessment Exercise – RAE (later renamed the Research Excellence Framework – REF) in 1986 and the foundation of the Arts and Humanities Research Council (AHRC) in 2005 contributed to the increase of funding opportunities for design researchers in the UK. Based on the results of REF, every year around £1.6 billion is allocated to higher education research institutes in the UK (Higher Education Funding Council for England, 2015). In recent years, the number of postgraduate design students has significantly increased, and research has become more valued both in teaching and professional practice. The growth of interaction, service, and social design as well as user-centred and participatory practices has required designers to possess research skills, apply design research methods, and be able to analyse data and synthesise and communicate their findings in effective and original ways (Rodgers and Yee, 2016). The current landscape of design research includes not only research 'into' (*i.e.* about) design, but also research 'for' and 'through' design (Frayling, 1993), cutting across disciplinary, conceptual and methodological boundaries. Present-day design research projects are highly collaborative and involve not only academic partners but also small and medium-sized enterprises as well as large industrial companies, adopting quite complex processes and

resulting in multi-layered outcomes, which are communicated in a multitude of formats (Rodgers and Yee, 2016).

Design research has evolved to respond to complex social, environmental, and cultural challenges such as those highlighted in the United Nations (UN) Sustainable Development Goals (SDGs). Therefore, design research has started to focus on addressing the global challenges we face, including those related to climate change, environmental degradation, poverty, inequality, health, education, prosperity, peace and justice (United Nations General Assembly, 2015). To tackle these issues, design research has evolved from a technical, product- and process-centric focus towards large-scale system-level changes (Ceschin and Gaziulusoy, 2016).

3 Analysis of 379 UK Design Research Projects

In order to explore the evolving landscape of design research in the UK, we have collected data from the UK Research and Innovation (UKRI) Gateway to Research (GtR) repository. Through desk-based research on GtR, nearly 20,000 research projects were returned initially featuring the word ‘design’ in their title and/or abstract (Figure 1).

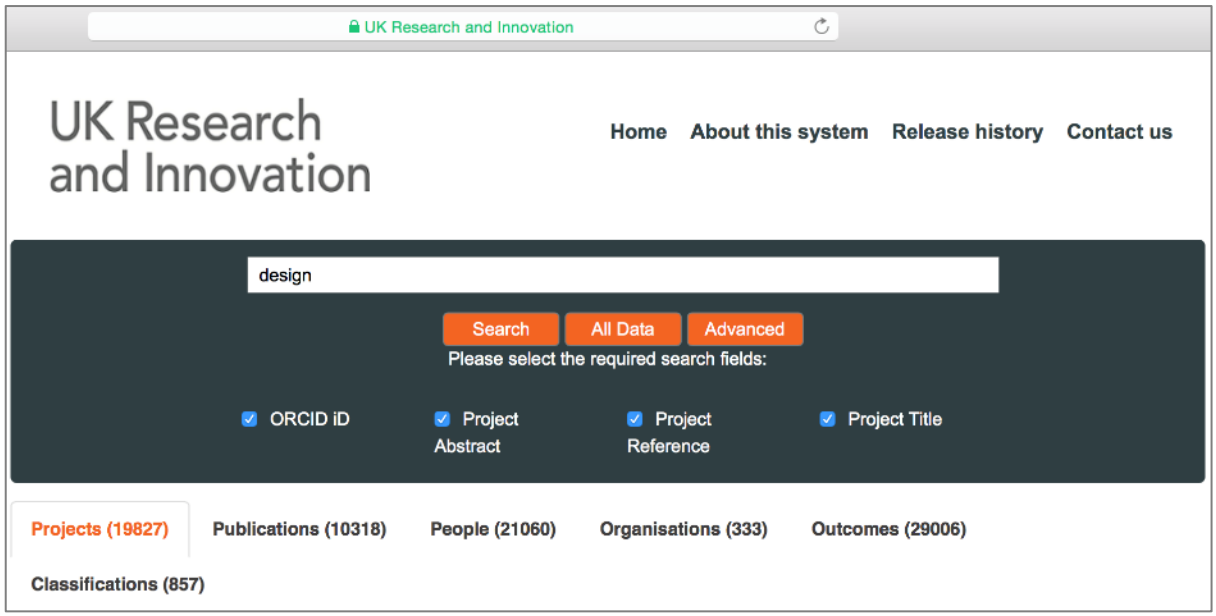

Figure 1. Initial results of the search for ‘design’ via the UKRI Gateway to Research returns 19,872 projects.

These include a wide range of projects funded from diverse UK Research Councils, such as the Arts and Humanities Research Council (AHRC), the Engineering and Physical Sciences Research Funding (EPSRC), the Economic and Social Research Council (ESRC), and the Medical Research Council (MRC). Such projects show how ‘design’ is widely used as both a verb and a noun, but also to describe products and processes. For the scope of this paper developed as part of the first author’s AHRC Design Leadership Fellowship, we have narrowed down the dataset to projects funded by the AHRC only. Furthermore, when a principal investigator submits his/her research proposal to the Joint electronic Submission system (Je-S) they are asked to classify it from a range of subjects and topics (Figure 2). In this paper, we have only included AHRC-funded projects which feature the word ‘design’ in their title and/or abstract and whose subject and/or topic was classified as ‘design’. Thus, this paper examines 379 AHRC-funded ‘design’ research projects covering the period 2006

to 2018 that shows the nature, scope, and diversity of the design research landscape in the UK (Rodgers, 2018).

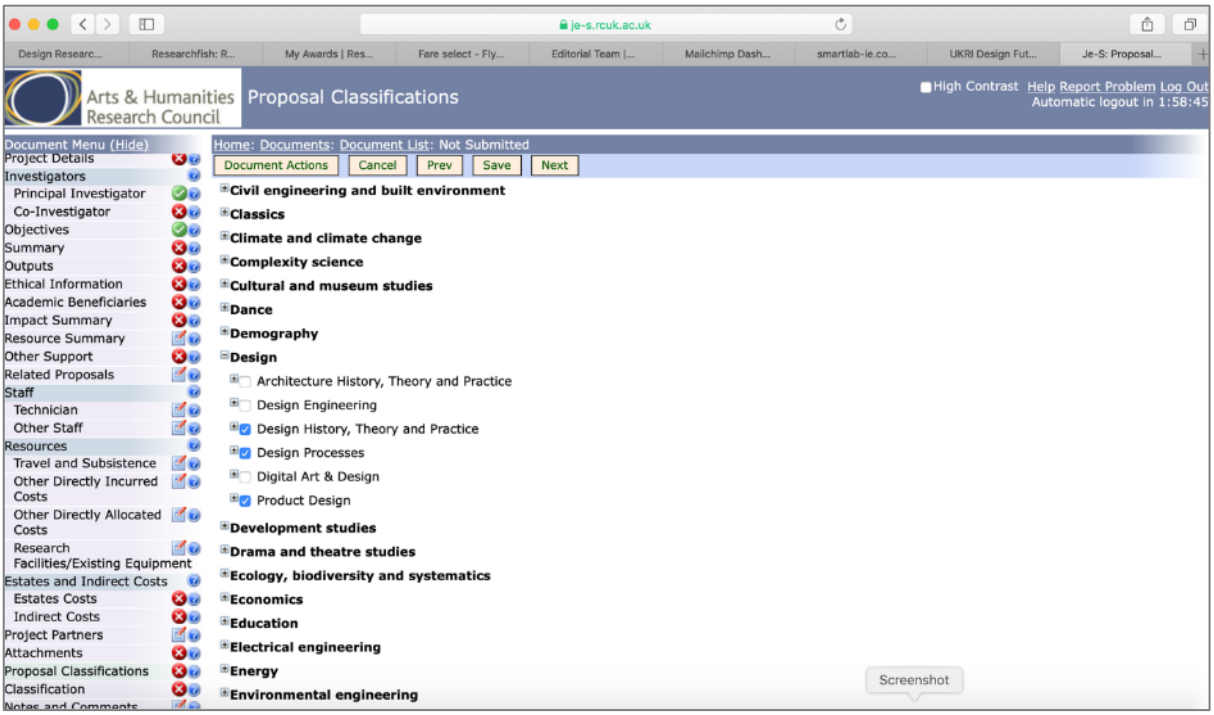

Figure 2. Research proposal classification on Je-S.

Based on this sample, we have undertaken a manual process of analysis of the 379 design research projects through reviewing the data gathered from GtR using selected components of the 'Design Research Conceptual Framework' developed by the authors (Rodgers *et al*., 2019) as *a priori* elements to unpick the 'designerly' content of each project. These elements include the design research project start date, financial value, project team, partner organisations, geographical location of the research organisation (RO) and collated the results into a Microsoft Excel spreadsheet (Figure 3), which was then used to draw graphs in Tableau software (Figures 6 to 14).

	A	B	C	D
1	**Project Title**	**Start Date**	**Project Organisation(s)**	**Region**
2	smART cities and waste…	01/02/2016	Bangor University, City of Maastricht, Free (VU) University of Amsterdam, London Legacy Development Corporation, University of Maastricht	Wales
3	Hidden Connections, Shared Environments and Environmental Flows…	09/02/2012	Birmingham City University, Fira Landscape Ltd, The Guiding Stars	West Midlands
4	Building the Wireframe: E-Science for the Arts Infrastructure	01/07/2006	Birmingham City University	London
5	Stories of User Appropriation	01/06/2013	Brunel University, iHealth Partnership, Industrial Design Consultancy Ltd	London
6	Measuring Social Values of Design in the Commercial Sector	01/02/2014	Brunel University, Designplus, Cardiff Metropolitan University, British Industrial Design Association (BIDA), Design Management Europe Award, PDR National Centre for Product Design, British Industrial Design Association	London
7	Unearth Hidden Assets through Community Co-design and Co-production	01/02/2013	Brunel University, Shinfield Rise Community Flat, Wiltshire Council, Glass-House Community Led Design, Arts Council England, Tidworth Mums, Kindle Partnerships, HealthWORKS Newcastle, Alison Gilchrist Consultancy, The Glass-House	London
8	Securing the value of Co-design for Community-based Organisations	14/02/2012	Brunel University, National Council for Voluntary Organisations (NCVO), MERU, Blackwood Foundation, Mondo Foundation, The Blackwood Foundation, Nat Council for Voluntary Organisations	London
9	Creation of High Wycombe furniture electronic archive	01/03/2006	Buckinghamshire New University	London
10	Ludic Artefacts…	27/04/2015	Cardiff Metropolitan University, Alzheimer's Society, Alzheimer's Australia NSW, Gwalia Cyf, Age UK, Gwalia Housing Society Ltd	Wales
11	[HN] People Powering Policy	01/09/2017	Cardiff Metropolitan University, Northern Ireland Department of Finance, The Scottish Government, Welsh Government, The Cabinet Office	Wales

Figure 3. Snapshot of data exported from Gateway to Research (GtR).

Next, we analysed the thematic focus of the 379 projects in relation to the 17 UN Sustainable Development Goals that have been set by the United Nations General Assembly in 2015 to drive sustainable development by the year 2030 (Figure 4).

Figure 4. The 17 UN Sustainable Development Goals.

Using the 17 UN Sustainable Development Goals as *a priori* codes for the process of thematic analysis, we have reviewed the abstracts of the 379 projects as reported on GtR and manually assigned each one of the projects to one or more of the SDGs, as shown in Figure 5.


The LAUGH project builds on the applicant's previous AHRC funded research investigating handcraft, playfulness and wellbeing and ORAN and HEFCW funded research into ageing. The UK Co-I will bring to the project track record of research concerning haptics and dementia and the international Co-I in technology, handcraft and wellbeing. The project will be supported by Wales' National Centre for Product Design and Research, which has extensive experience in design research and product development. This project proposes an investigation into handcraft and playfulness in relation to dementia in order to inform the development of ludic artefacts (age appropriate toys) to support the wellbeing of people with dementia (PwD). The aim is to develop innovative playful devices that amuse, distract, comfort, engage, bring joy, and promote 'in the moment' living. The proposed research is timely as it addresses the call by the World Health Organization and the G8 Dementia Summit for international collaboration in order to address the global challenge of the ageing population.Many older people enjoy creative pursuits and leisure activities that involve making and crafting such as knitting, crochet, woodcraft and DIY etc. People with dementia may be able to continue to practice craft skills learnt earlier in life; however memory of the structure and rules of making, reliant on cognitive function, may decline. For example PwD may continue to be able to form the stitches when knitting but can no longer follow a knitting pattern; the rhythms of making, muscle memory and emotional memory systems appear to be retained despite cognitive degeneration. This investigation will examine ways in which hand use, rhythms and gestures found in traditional handcrafting activities can be used to inform the development of playful artefacts. The intention will be to design new playful devices to amuse and stimulate people with dementia and bring them joy, fun and laughter. The research will investigate how handcrafting promotes positive emotion; identify the manual skills that are retained despite cognitive decline in PwD and examine the ways in which haptics, gesture and sensory stimulation contribute to subjective wellbeing in later life. Those in the caring professions advocate the use of children's toys and have observed the comfort they bring to people with dementia. However there is an acknowledgment by professionals of the stigma attached to PwD playing with children's toys. This is attributed to a perceived loss of dignity, mainly by relatives and friends, rather than the person with dementia themselves. Findings from the applicant's previous research indicate there is currently a need for age appropriate playful devices specifically designed for people with dementia. This project proposes inclusive participatory design research to inform the development of new kinds of playful devices. These will build bridges between craft and hobby activities that are perceived positively by society and toys that are not. Playful artefacts will be developed to support the wellbeing of those for whom life has become limited due to memory loss or cognitive impairment. The research will investigate ways of integrating smart materials and digital technology into designs to supplement physical and material properties. It proposes to explore new ways of augmenting traditional craft activities to provide additional sensory and communication properties. This will make it possible for PwD to interact with the devices either independently or socially and provide opportunities to personalise the experience (for example by including family photographs or favourite music). By integrating electronics and sensors, designs for new types of age appropriate toys will be developed. A toolkit for designing playful devices for PwD will be proposed, based on the findings from the research, in order to inform the design community and care professionals working in the sector
3 GOOD HEALTH AND WELL-BEING

Figure 5. Thematic analysis of a sample of the 379 design research projects using the UN SDGs as codes.

4 Results

Through the above-mentioned process of analysis of the data gathered from GtR, we have mapped the evolution of UK design research over time, in relation to the number of funded projects, their financial value, the number of project investigators, the number and type of partner organisations, the geographical spread of the projects, as well as their contribution to addressing the UN SDGs. The findings from the data analysis are discussed in the following sections of this paper and illustrated in the accompanying figures.

4.1 Evolution of Number and Financial Value of Projects

Figures 6 and 7 (below) provide clear evidence that design research in the UK has undergone alternative waves of decline and growth over the last twelve years. In general, the number of design research projects funded by the AHRC increased from 40 in 2006 to 45 in 2018. However, a 40% decline of funding is seen between 2007 and 2008, when the number of AHRC-funded design research projects decreased from 40 to 16. Moreover, the lowest numbers of AHRC-funded design research projects are 9 and 8 respectively in 2010 and 2011; whereas between 2011 and 2012 we see a 462% increase, while the highest peak was reached in 2018 when 45 projects received funding.

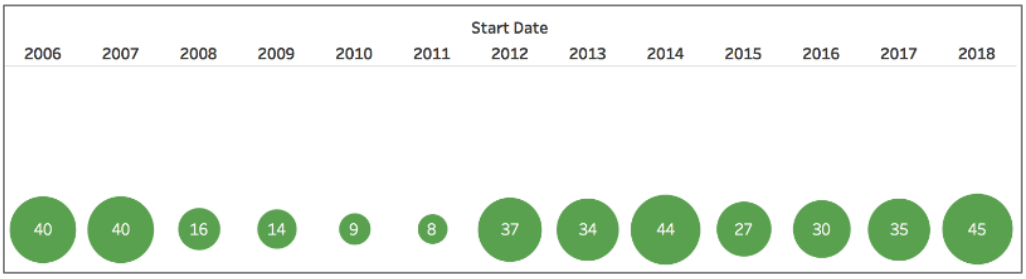

Figure 6. Number of design research projects funded by the AHRC from 2006 to 2018.

Figure 7 shows that the cumulative financial value of the 379 design research projects drastically rose from £4.7 million in 2006 to £33.6 million in 2018 (a 715% increase). The design research total value of £33.6 million in 2018 was awarded across 45 projects. It is important to highlight that a large portion of this amount was given to 5 Research and Development Cluster Partnerships, which have received over £5.5 million each and involve a high number of project investigators and partner organisations over a long period of time. Moreover, it is evident that in the period between 2008 and 2011 UK design research experienced a decline of funding from the AHRC, with the lowest cumulative value being £490,773 in 2011, followed by a steady increase of funding since 2012.

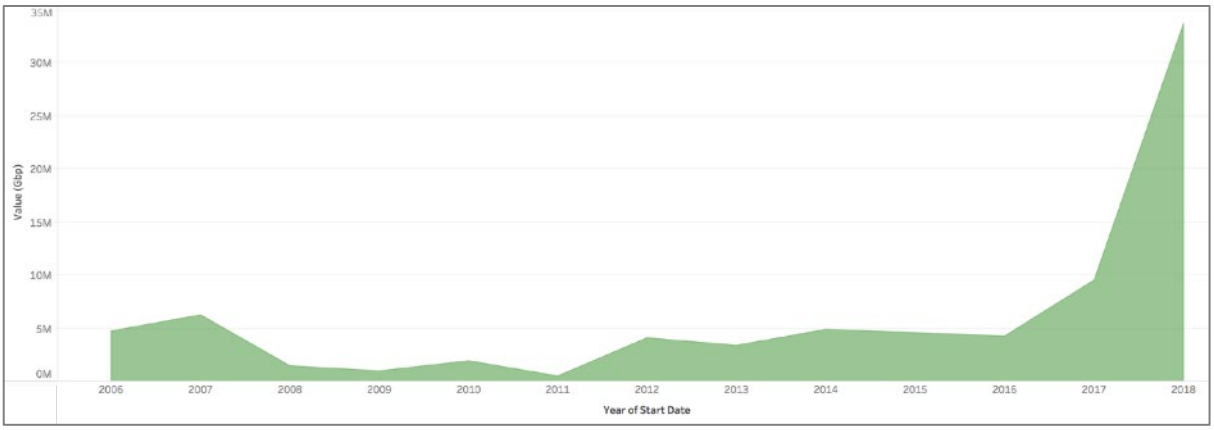

Figure 7. Cumulative financial value of the 379 design research projects per start year of the projects.

Overall, by analysing the two diagrams in parallel, it emerges that the number of funded projects and their cumulative financial value decreased from 2006 to 2011 and has doubled in the years since 2012. Although one may think that the highest financial value corresponds to the highest number of funded projects, a closer look at the two graphs shows some exceptions. For example, over £9.4 million was allocated in 2017 to support 35 projects, whereas the 44 projects funded in 2014 cumulatively received only £4.8 million. Hence, if we consider that the AHRC has awarded more funding for fewer projects in specific years, we might conclude that this suggests greater focus is being placed on specific research areas.

4.2 Evolution of Number of Project Investigators

Figure 8 illustrates the evolution of the number of project investigators (*i.e.* principal investigator, co-investigators and researchers) that make up the teams of the 379 AHRC-funded design research projects between 2006 and 2018. It is evident that the majority (*i.e.* 93%) of these design research projects are undertaken by teams of less than six people. Exceptionally, one project funded in 2016 involved a team of 43 investigators, while in 2018 three projects involved 22, 19, and 18 project investigators. Figure 8 also shows that a large number of projects (*i.e.* 21% of the total 379 analysed here) were led only by one principal investigator (without involving any co-investigators or researchers), especially in the early years (*i.e.* between 2006 and 2011).

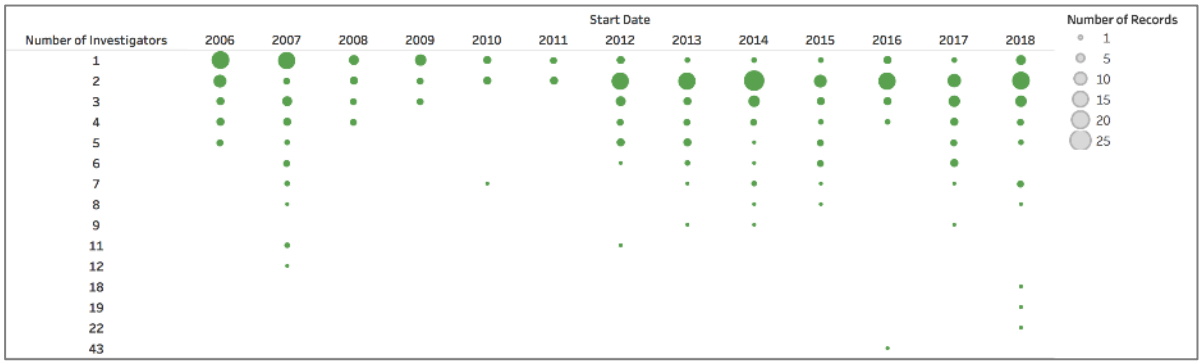

Figure 8. Project team size by start year of the 379 design research projects.

Analysing the sample of 379 AHRC-funded design research projects against the broader context of the global design sector, the findings here reinforce a highlight of the recent Beazley Designs of the Year 2017 exhibition at the Design Museum in London that revealed that over 78% of the nominated projects were developed by small teams of less than 10 people.

4.3 Evolution of Number and Type of Project Partners

From Figure 9 it is evident that nearly half (45%) of the design research projects analysed here involve only one research organisation. Similar to the project team size (Figure 8), the majority of partner organisations involved in UK design research projects are undertaken by less than 5 organisations (80% of the 379 projects). However, Figure 9 shows some exceptions, with one project funded in 2018 involving 31 partner organisations, one project starting in 2015 having 35 partners, and one project in 2014 involving 65 organisations. The analysis of the 379 design research projects also demonstrates that, between 2006 and 2009, AHRC-funded design research projects involved 6 or less project partners before a significant rise in the number of partner organisations in 2012 to 37. Since 2012, the overall number of project partners per year has ranged between the mid 20s to the mid 40s. This general increase in the number of project partners involved in AHRC-funded design research

projects hints at greater awareness of design research relevance and applicability and therefore greater interdisciplinarity and collaboration.

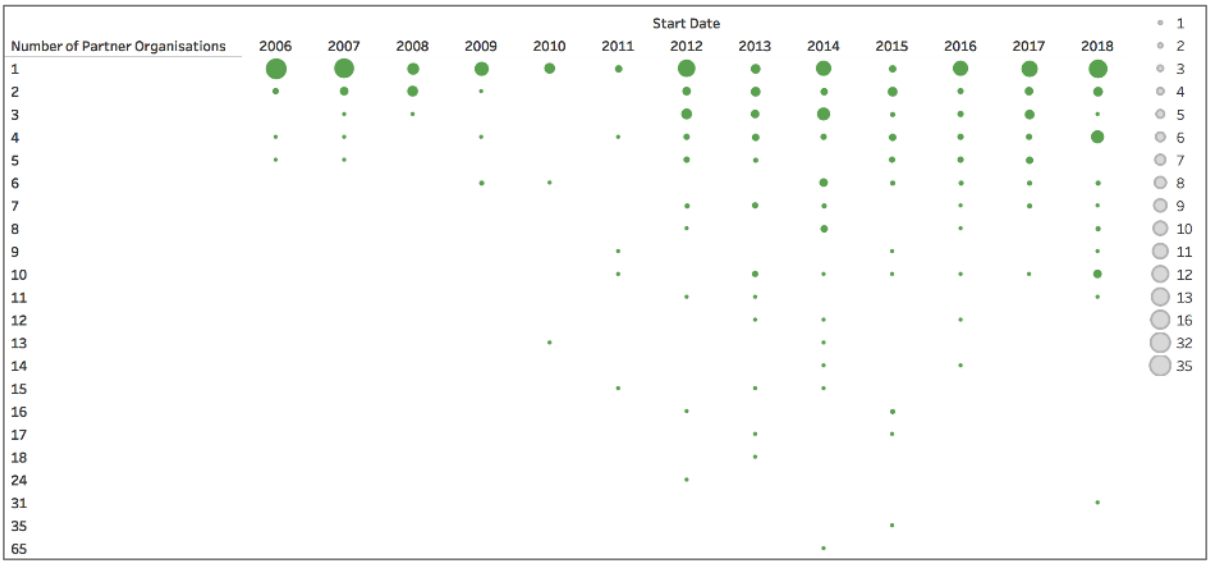

Figure 9. Number of partner organisations by start date of the 379 design research projects.

We have also examined the type of organisations involved as partners in the 379 design research projects, shown in Figure 10. Most of them are led by a research organisation (RO), which, in 97.6% of the cases, is a higher-education institution (HEI). However, eight projects are led by four cultural organisations (*i.e.* the Victoria and Albert Museum, the National Museum of Scotland, the Historic Royal Palaces, and the Science Museum), one project is led by a commercial partner (*i.e.* Connected Digital Economy Catapult), and one by a non-ministerial government department (*i.e.* the National Archives). Besides higher-education institutions (HEIs), we have also identified five other types of organisations involved as partners in the 379 design research projects analysed here. These are predominantly commercial organisations (number = 279 *e.g.* Burberry), and charities (number = 225 *e.g.* Age UK), governmental bodies (number = 155 *e.g.* Scottish Government), not-for-profit organisations (number = 63 *e.g.* UNESCO), and 32 funding bodies (number = 32 *e.g.* German Research Foundation).

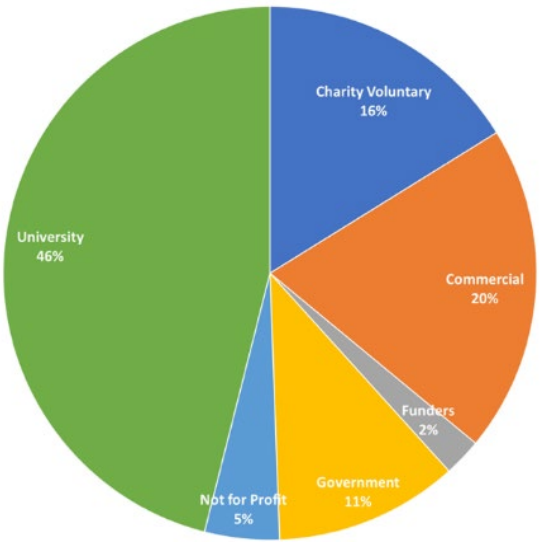

Figure 10. Types of project partner organisations (including lead ROs) of the 379 design research projects.

It is clear that the UK design research landscape is becoming more and more collaborative and interdisciplinary in nature. This is shown by the increasing number of project partners collaborating with teams of academic design researchers and emphasised by the growing diversity of types of organisations collaborating with higher-education institutions to address complex issues.

4.4 Evolution of Geographical Spread of Projects

This section reports on the geographical spread of the 379 design research projects over the last 12 years. It is evident from Figure 11 that while some regions – such as London, Scotland, the South West and the North West of England – have received AHRC funding almost every year from 2006 to 2018, funding has been rather discontinuous in other regions. Some barren periods have emerged from the analysis of the 379 AHRC-funded design research projects shown in Figure 11. In particular, while the North East and Wales regions experienced little-to-no AHRC funding from 2007 to 2011 and from 2007 to 2012 respectively, the East of England did not receive any funding in the period 2009 to 2010 nor between 2013 and 2016 inclusive. Moreover, Figure 11 clearly shows that the highest financial value across the period analysed here was awarded to London and Scotland in 2018. Interestingly, a high amount of funding (*i.e.* £4.7 million) was awarded to a research organisation in the Yorkshire and The Humber region, which had not received much financial support from the AHRC in the preceding period.

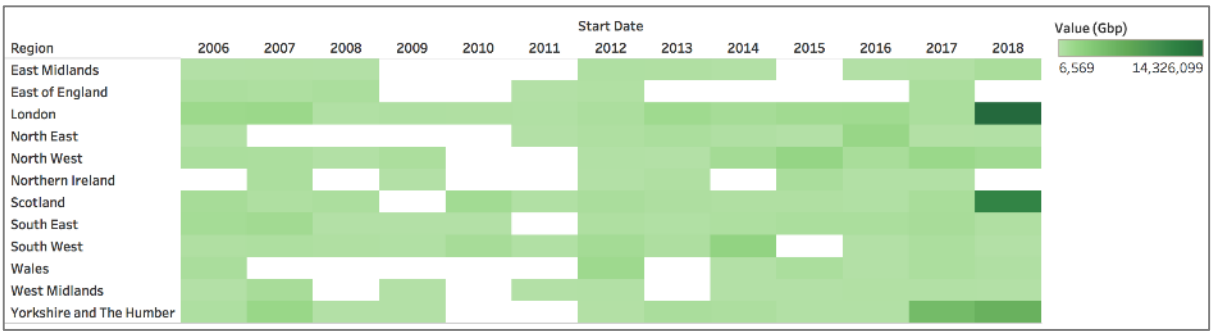

Figure 11. Geographical spread of the 379 design research projects across the UK over time.

Considering each of the 12 UKRI regions, Figure 12 (below) clearly shows that London is the region with the highest number of AHRC-funded projects (*i.e.* 85) in the period analysed here, followed by Scotland (where 53 projects received AHRC funding). Conversely, Northern Ireland and the East of England are the regions whose research organisations have held the lowest numbers of AHRC-funded design research projects (*i.e.* 9). Furthermore, if we focus on each of the UKRI regions, it emerges that the portfolio of projects funded in London is spread amongst the highest number of research organisations (ROs) (*i.e.* 22), while only two ROs in both Northern Ireland and the East of England have received funding from the AHRC in the period analysed here.

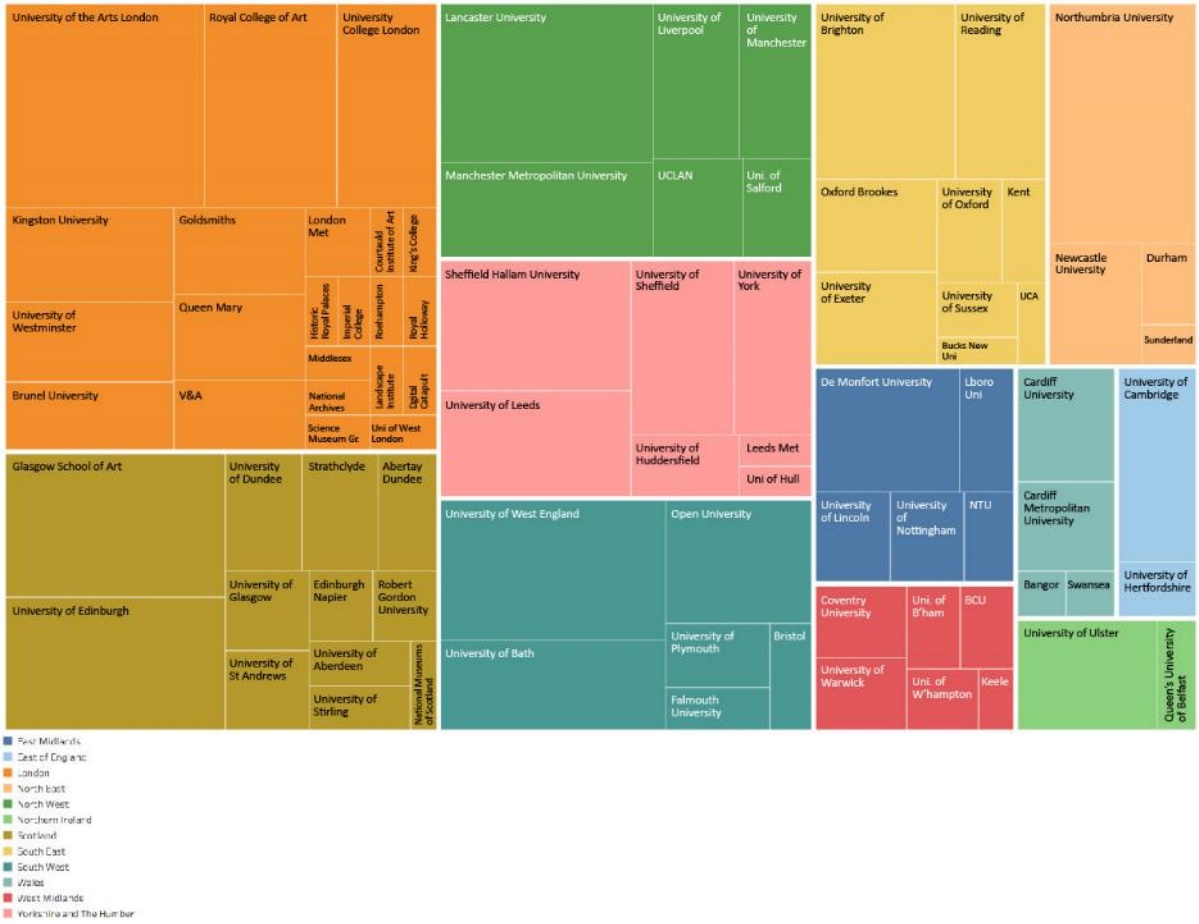

Figure 12. Number of design research projects funded across lead ROs in each of the twelve UKRI regions. The size of the rectangles represents the number of design research projects funded in each RO.

4.5 Evolution of Projects' Focus on the UN Sustainable Development Goals

The thematic analysis of the 379 AHRC-funded projects, based on the UN Sustainable Development Goals, shows that design research is increasingly concerned with addressing a range of complex challenges. In addition to the 17 UN SDGs, we have added an 18th Goal because nearly one quarter of the 379 AHRC-funded design research projects examined here address issues of cultural sustainability and aim at preserving heritage through archival studies as a way of learning from history in order to inform and shape a more sustainable future. Figure 13 gives a visual overview of the 379 design research projects and the evolution of their main area of focus from 2006 to 2018 in relation to the UN SDGs.

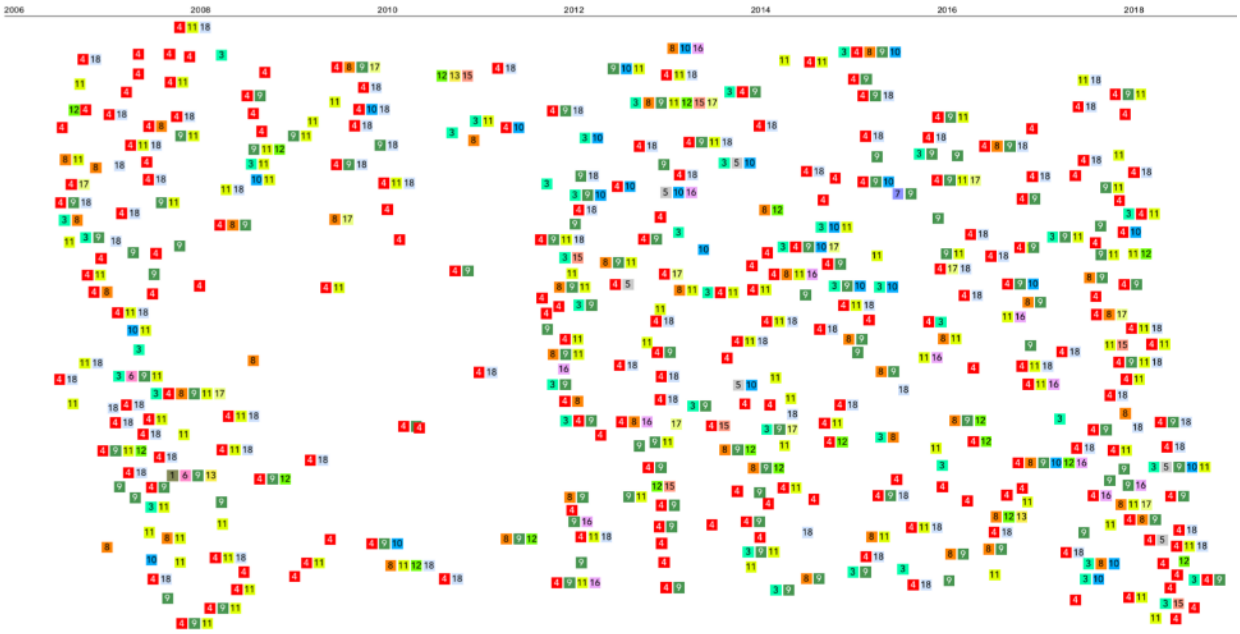

Figure 13. Spread of the 379 design research projects' focus on the UN SDGs over time.

It is clear from Figure 13 that AHRC-funded design research projects are increasingly focusing on addressing issues related to the UN SDGs (*e.g.* quality education, sustainable cities and communities, quality education). In particular, we can see that since 2012 design research projects have much greater engagement with the UN SDGs. Figure 13 also shows that most of the 379 design research projects are associated with more than one UN SDG. Indeed, some projects are tackling two, three, and even four UN SDGs. Consequently, the total number of UN SDGs involved in design research projects here is almost double the number of projects. That is, 727 UN SDGs were assigned across the 379 design research projects. Therefore, it results that many AHRC-funded design research projects tackle complex issues often traversing several UN SDGs at the same time, covering areas such as healthcare, transport, decent work and economic growth, industry, and responsible consumption and production. We can see that in recent years there has been an increase of AHRC-funded design research projects concerned with issues of good health and wellbeing and a decrease in research with a focus on preserving heritage. This suggests that design researchers are becoming less concerned with investigations focused on the past and seem to be taking a more active stance in implementing change in various sectors. This adds weight to the point made earlier regarding design research continually evolving as it responds to ever-changing contexts. For instance, the increasing focus on UN SDG 3 "Good Health and Wellbeing" may be related to the UK design research's community response to the 'Strategic Plan for the Next Four Years' set out by Public Health England in 2016 to achieve better outcomes in protecting and improving the nation's health and wellbeing by 2020.

Figure 14 shows the sum of all the occurrences of each of the 17+1 UN Sustainable Development Goals across the sample of AHRC-funded design research projects analysed here. As can be seen in Figure 14, the UN SDG 4 "Quality Education" appears in 29% of the 727 UN SDG occurrences. These projects tackle issues such as equitable and inclusive quality education and learning opportunities for all as a pathway towards improving people's lives. One example of an AHRC-funded design research project that addresses the UN SDG 4 is "*Design Matters? The Effects of New Schools on Students', Teachers' and Parents'*

Actions and Perceptions". This project investigates the effectiveness of newly designed schools and the creation of suitable environments for teaching and learning. The UN SDG 9 "Industry, Innovation and Infrastructure" is the second most recurring goal among our sample of AHRC-funded design research projects. In fact, 17% of the 727 UN SDG occurrences are concerned with challenges for industry, innovation and infrastructure. These projects aim at supporting inclusive and sustainable industrialisation, triggering innovation and creating resilient infrastructures. This is clearly exemplified by the "*Design Innovation for New Growth (DING)*" project, which uses design as a strategic tool for enabling growth and innovation in the creative economy of the Highlands and Islands. Another highly recurring goal is the UN SDG 11 "Sustainable Cities and Communities"; in fact, 15% of the total occurrences related to projects dealing with sustainable living in cities and communities. This includes design research projects which aim at making cities and communities safe, inclusive, sustainable and resilient, places where everybody has access to basic services, such as housing, energy, and transportation.

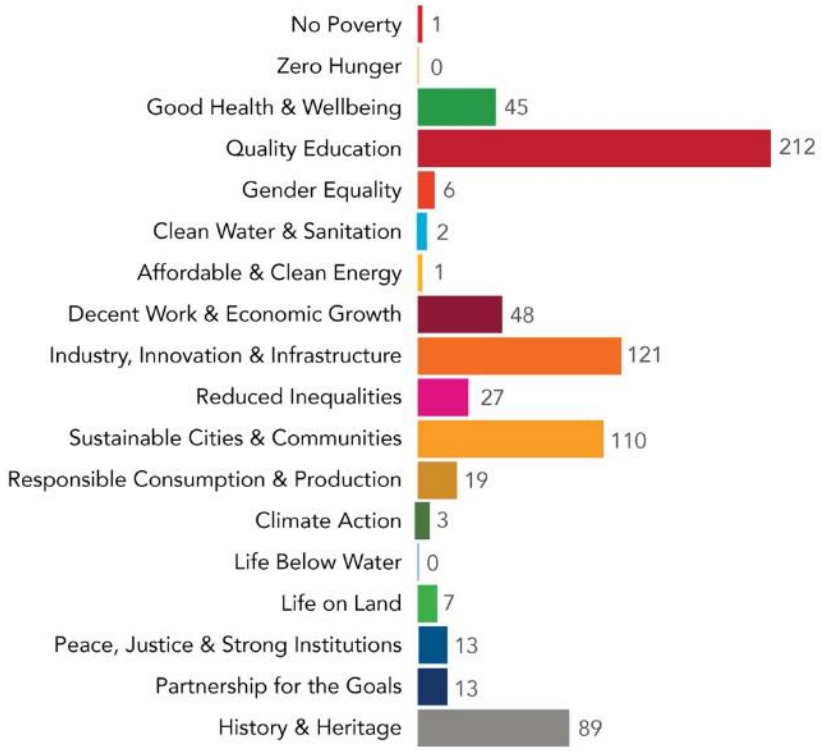

Figure 14. Sum of occurrence of UN Sustainable Development Goals across the 379 design research projects.

5 Emerging Goals and Overlooked Issues

Figure 14 highlights that design research projects funded by the AHRC in the UK are not tackling some of the most significant issues we currently face in the world. In fact, there are clear gaps amongst some very complex issues that are currently being overlooked by AHRC-funded design research. These include projects that seek to eradicate poverty, address hunger, foster gender equality, provide clean water and sanitation, supply affordable clean energy, and address important environmental issues on land and water.

It is worth acknowledging, however, the limitations of the sample we have analysed for this paper developed within the scope of the first author's on-going AHRC Design Leadership Fellowship in the UK, without considering similar trends in other countries. First, this paper

only deals with UK-based design research projects funded by the AHRC and will therefore omit design research projects that reside beyond the remits of the AHRC or are developed in other countries. Second, the paper only covers the analysis of AHRC-funded design research projects until the end of 2018 and may miss some projects funded between then and now. Nevertheless, we can conclude from the significant gaps and overlooked issues shown here that design research still has a long way to go towards tackling these and other complex global challenges to activate positive social, cultural, environmental and economic change.

6 Conclusions

This paper has presented the evolving landscape of design research as it responds to ever-changing demands. Contemporary forms of design research are increasingly multidisciplinary, contributing new knowledge not only to the canon of the design discipline but also to other fields, including healthcare, business, computing, and engineering. Design research processes are increasingly collaborative, involving not only teams of design researchers and practitioners, but also end-users, stakeholders, and researchers from other disciplines working in co-design processes, as well as industries and other types of non-commercial partners. In the paper we have provided a brief overview of the history of design research in the UK and discussed the establishment of a research culture grounded on 'designerly ways of knowing' that increasingly makes a significant contribution to address some of the most complex challenges we face in the world.

The paper provides a review of 379 AHRC-funded design research projects between 2006 and 2018 that exemplify the depth and breadth of the UK's design research landscape. Through a thematic analysis of these projects, we have unpacked the evolution of the quantity of design research projects funded by the AHRC, their financial value, the size of their project teams, the number and type of partner organisations, the geographical spread of projects across the UK, and their contribution to addressing the UN Sustainable Development Goals. The paper highlights that the number of design research projects funded by the AHRC drastically declined between 2010 and 2011, and sharply increased after 2012. We can conclude that this trend may be externally induced by the establishment of design as a priority area within the AHRC. The cumulative financial value of the 379 design research projects analysed here increased by over seven times from 2006 and 2018, perhaps due to internal drivers in design academia, such as the establishment of R&D cluster partnerships which involve large teams of investigators and numerous partner organisations. The sharpest decline of AHRC funding was witnessed between 2009 and 2011, perhaps as a consequence of the global financial crisis of 2008.

In terms of team size, it emerged that the majority of AHRC-funded design research projects are undertaken by teams of 6 or less individuals. Interestingly, almost all the projects started in 2010 and 2011 were led by only one principal investigator without involving any co-investigators or researchers; this is the case especially with projects focusing on design history, theory and practice, which are often led by a single academic. Moreover, the analysis shows that most of the 379 AHRC-funded design research projects are led by one research organisation in collaboration with up to five partner organisations, classified predominantly as commercial institutions and charities, but also governmental bodies and a small number of not-for-profit organisations and funding bodies. The paper also highlights that some UK regions (*i.e.* London, Scotland, the South West and the North West of

England) have consistently received funding from the AHRC throughout the period analysed here. However, we have also identified some gaps of funding in other regions (*i.e.* the North East, Wales, and the East of England). Furthermore, while highlighting that London is the region with the highest number of projects funded by the AHRC across the period analysed here, the lowest number of funded projects were registered in Northern Ireland and the East of England. Given such disparities, the AHRC may need to work harder to achieve a more equitable spread of design research funding across the regions and research organisations in the UK whilst ensuring high quality research.

Finally, using the UN Sustainable Development Goals as a framework to analyse the 379 AHRC-funded projects shows that present-day design research is tackling a multitude of complex challenges. These are mostly related to issues of quality education, and more recently, an increasing number of research projects has been concerned with health and wellbeing perhaps as a result of the design research community responding to the strategic plan set out by Public Health England in 2016. We have also identified that a large number of the 379 AHRC-funded design research projects relate to heritage and preservation issues, although more recently design research appears to be less concerned with investigations focused on the past and is taking a more active approach towards present-day challenges. The analysis conducted here also shows that there are a number of serious global issues (such as poverty, hunger, gender inequalities, sanitation, energy, and land) that AHRC-funded design research in the UK, thus far, has largely ignored. Finally, as the role of design research continues to evolve, we hope that it will continue to lead on responses to the ever-changing social, cultural, economic and environmental contexts in which it is developed.

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Unblocking the Circular Economy

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There is a blockage in the Circular Economy. Discarded plastic products end up in the Indian Ocean where thousands of tonnes of waste plastic is washed up on the beaches of East Africa. This creates a detrimental impact on both the marine ecosystem and the economy where the locals rely on coastal fishing, trade and tourism for their livelihoods.

Plastic comes ashore in many forms and is badly degraded by the elements such that when processed locally, the quality of the recycled material cannot meet the needs of the community. The researchers worked with shoreline communities to help develop a processing method capable of giving waste plastic a valuable second life. As a demonstration of the potential of this new recycled material they constructed a traditional dhow sailing boat entirely from plastic trash collected from Kenya's beaches and towns. During its 500 kilometre maiden voyage from Lamu in Kenya to Zanzibar in Tanzania, the researchers stopped at communities along the way to change mindsets about plastic waste.

This paper practically demonstrates how an environmentally and economically damaging waste problem can be re envisaged as a valuable resource that supports the local and regional economy and unblocks the circular economy in the shoreline communities of East Africa.

Keywords: Circular economy; design innovation; dhow; plastic recycling.

1 Introduction

Annually, thousands of tonnes of plastic products are discarded and end up the Indian Ocean. Plastic waste is washed up on the beaches of Kenya in East Africa. This impacts detrimentally on both the marine ecosystem and the economy of the country where the locals rely on coastal fishing, trade and tourism for their livelihoods.

This case study that demonstrates how, a group of people, were able to unblock the Circular Economy in Kenya by building a dhow.

Figure 1. The Flipflopi during a beach event in Diani Kenya!

Appalled by the volume of waste plastic he found on the deserted beaches of Kenya, project visionary Ben Morrison decided to turn the trash that had been washed up into something useful that could communicate the importance of keeping our oceans free from single use plastics to a global audience.

1.1 The Marine Plastic Problem

The Indian Ocean is surrounded by some of the most prolific contributors to marine pollution on the planet and the currents in action in the Indian Ocean deliver waste onto the shores of East Africa.

It is estimated that 5 countries, China, Indonesia, the Philippines, Thailand, and Vietnam dump more than half of all ocean plastic waste that originates from the land (Ocean Conservancy, 2015).

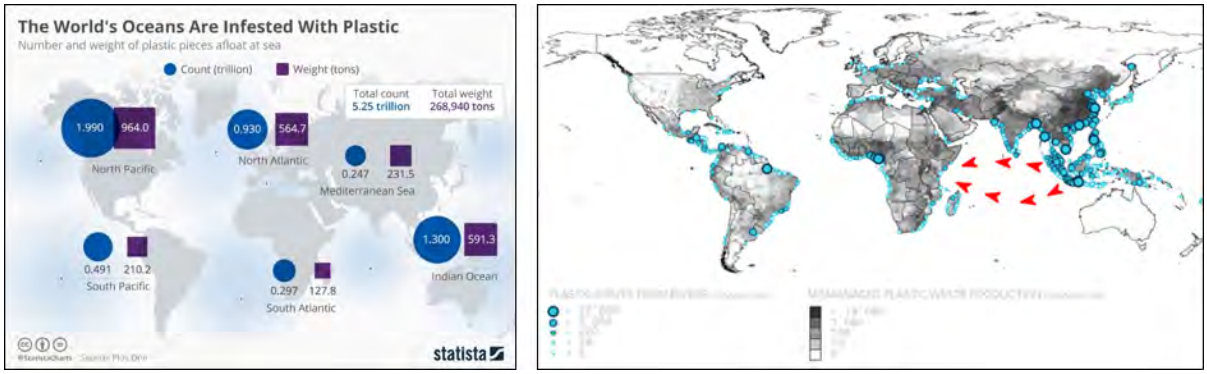

Figure 2. The main contributors to marine pollution, hotspots of river based waste and red arrows depicting the Indian Ocean currents that drive waste onto the East African coast from Asia.

It is estimated that over 12.7 million metric tons of plastic (Jambeck, 2015) enter the oceans each year, this originates mainly inland but then flows into the rivers and then out to sea. Between 88% and 95% (Schmidt, 2017) of this waste emanates from ten rivers, eight can be

found in Asia and two in Africa. It has been estimated that there is almost 60,000 tons of plastic floating in the Indian Ocean alone (Eriksen, 2014). Plastic waste is a major problem for marine life, it can be ingested and lager animals can become entangled in it. Larger pieces are broken down into smaller particles that can then leach toxic chemicals into the sea. In 2010 a massive marine plastic waste patch was discovered in the Indian Ocean (Parker, 2014) measuring roughly 2 million miles^2 (about 5 million km^2), this is continuing to grow!

The number of people who depend on the oceans as their primary source of protein is increasing, fish represents almost 20% of the average intake of protein (per capita) for about 3.2 billion people worldwide as reported by the Food and Agriculture Organization of the United Nations (FAO, 2018). Contamination of the sea and marine life has a direct effect on the people who live on this coastal communities.

Only nine per cent of the nine billion tonnes of plastic the world has ever produced has been recycled. The overwhelming majority of plastics, including plastic drinking bottles, plastic bottle caps, food wrappers, plastic grocery bags, plastic lids, straws and stirrers, and foam takeaway containers, are designed to be thrown away after a single use, ultimately ending up in our environment.

Some key facts:

- A single plastic bottle can almost 450 years (NOAA, 2019) or more to degrade.
- Over 12.7 million metric tons of plastic enters the ocean every year. The ocean is expected to contain (MacArthur, 2016) 1 tonne of plastic for every 3 tonnes of fish by 2025, and by 2050, more plastics than fish (by weight).
- Only 9% of the 8.3 billion tonnes of plastic the world has ever produced has been recycled (Economist, 2018).

This global problem can be simply illustrated in Kenya. In November 2016, 35 tonnes of plastic was collected from a 10km beach in Lamu in Northern Kenya. In a one 3 hour beach clean-up that was organised locally by the community, 5.8 tonnes of plastic was cleaned up and they had to stop because the sun was too hot.

This has a detrimental effect on the economy of the country, especially Kenya where its biggest natural asset is its environment.

1.2 The impact of ocean waste in Kenya

The plastic that litters the shores of Kenya has reached the end of its life and has no direct use. This impacts detrimentally on both the local marine ecosystem and the economy of Kenya where the locals rely on coastal fishing, trade and tourism for their livelihoods.

- Politically Kenya is a leading nation in the fight against marine pollution, in August 2017 it was the first county in the world to ban the use of single use plastic bags.
- The plastic on the beaches is affecting the local communities reducing the amount of fish they can catch.
- One example highlights the way that pollution enters the food chain, this is called bioaccumulation, tiny plastic particles are ingested by plankton that is then consumed by the fish that are eaten by the people who live on the coast.
- Larger pieces of plastic are eaten by larger marine animals and entanglement is also an issue.
- Casper van de Geer, a project manager with the Local Ocean Trust, a Watamu organization states that “in polluted beaches, turtles have to dig through the

marine debris to lay eggs. Hatchlings get stuck in the debris when they hatch. Once they escape and swim into the middle of the ocean, only to find heaps of mixed plastics, netting and other debris". (Mbugua, 2018)

- Ali Skanda (The Flipflopi Chief Boat Builder) reports that the local fishermen often catch more plastic in their fishing nets than actual fish.

Plastic waste comes ashore in many forms and is badly degraded by the elements such that when processed locally, the quality of the recycled material resembles the consistency of a Crunchy bar. This low-grade recycled material is not strong enough to meet most functional needs of the community.

1.3 There is a block in the Circular Economy

The majority of the plastic that reaches the shores of Kenya is unusable, it cannot be maintained, reused or refurbished. These are key factors governing the Circular Economy, the final option open to the locals is to recycle the material, this this is expensive as the plastic is badly degraded due to environmental factors such as UV radiation.

Waste plastic is collected from the coast but there are currently limited options for recycling. Watamu Marine Association works with EcoWorld Watama to organise beach clean-ups, they use the plastic found on the beach to create small pieces of art that can be sold back to the tourists but this only accounts for a very small amount of plastic that can be recycled. The beach clean-ups in Lamu for example have created a 60 tonne pile of plastic that cannot be recycled using existing techniques that EcoWorld Watama could offer.

There is a blockage in the circular economy and tonnes of plastic waste is piling up behind it. However, as the flow of material is linier, the aim of this research is to remove the block so that recycled material can flow back into the system.

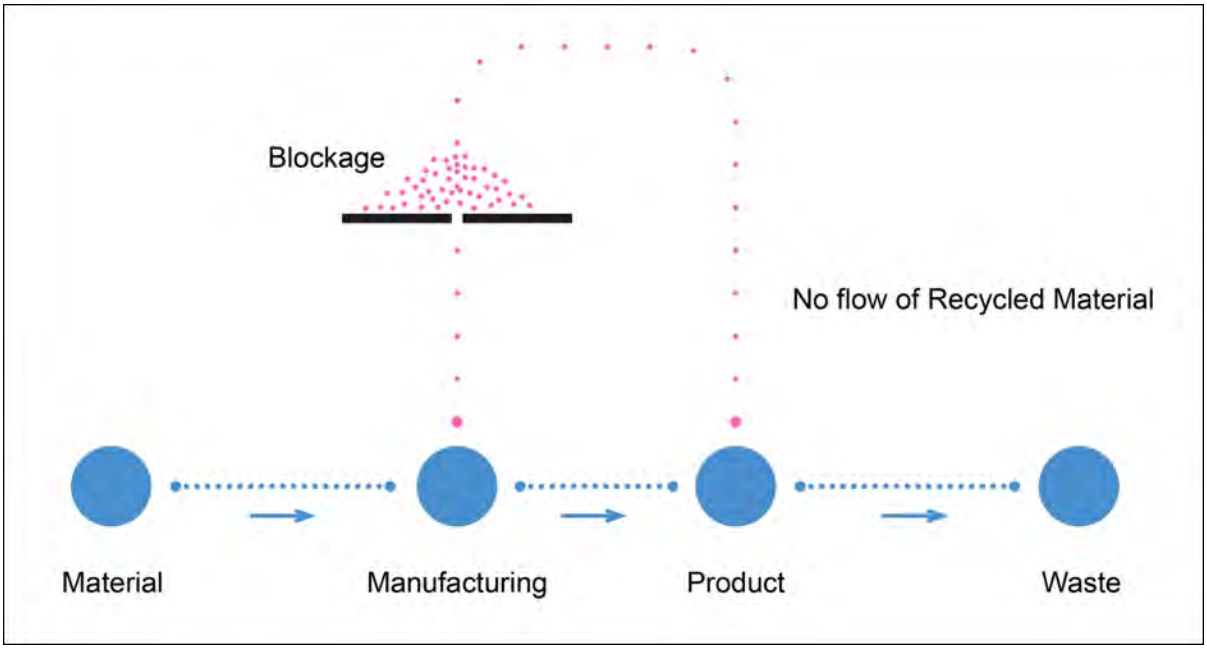

Figure 3. The Blockage in the Circular Economy.

1.4 Turning waste plastic into something useful

Shoreline communities are keen to find solutions to the problems of plastic waste and are constantly looking for ways to turn it into something viably useful that can help their communities and local economy. However when processed locally, the quality of the recycled, material is not good enough to be used to manufacture durable products that give

the plastic a second life! This means that recycled products tend to be limited to large, less refined structures.

Some good recycling options exist in the construction industry (Shini, 2018):

- Roofing Tiles: Lighter material, easier, quicker installation and a lower carbon footprint.
- Concrete: Recently studies (Schaefer, 2018) show that by adding recycled plastic to cement they can get a stronger and more resilient material.
- Indoor Insulation: Easy installation, durability and long-term energy saving.
- Structural Lumber: Picnic tables and benches, no need for preservatives and great durability.
- PVC Windows: Longer lifetime (up to 40 years), there is a surplus of production material and the same insulation quality as regular plastic.
- Bricks: Bricks can be moulded like LEGO making the construction process much quicker, it can also be made fire-resistant and is cheaper and eco-friendly.
- Fencing: Offers longevity, durability and there is no need for paint as the colour can be added in during recycling process.

All these materials can be produced locally but to a much lower tolerance than is possible in more developed counties that can invest in more expense machinery.

1.5 Challenging the community to produce high quality recycled material by building a sailing dhow

There is a demand for boats to be manufactured all along the coastline of East Africa, for fishing, trade and tourism. Dhow's have been used throughout this part of the world for thousands of years, traditionally they are manufactured from Teak, Mahogany and Mango. These materials are becoming harder to acquire so new materials are required to be used in the manufacture of these boats.

Recycled plastic can meet this need as traditional craftsmen can use it in very much the same way as they have been making boats for years. Good quality recycled plastic also has the added benefits found in the construction industry, such as longevity, durability ultimately, a longer lifespan, especially when used in the harsh environments found in the oceans.

2 Recycling materials to make a dhow

To put this paper in context, it is important to understand how dhows are constructed. Dhow construction techniques are thousands of years old and the dhow is one of the first designs of boat that helped humans trade across large expanses of water.

Traditionally they have Lateen sails that were developed by the Romans to be able to tack into the wind, this was a radical improvement on previous sail technology. They are predominantly found in the Persian Gulf, East Africa, Yemen and the coastal areas of South Asia including Pakistan, India and Bangladesh (Dhow, 2018).

2.1 Traditional dhow building methods

Traditionally the process of constructing a dhow involves the following stages:

- The boat builder lays the keel, which is made from a hardwood such as Teak or Mahogany.
- Ribs are attached to the keel, these are often made from Mango, craftsmen use the naturally occurring twists in the mango to create the bends in the ribs.
- Strakes are attached to the outside of the ribs, these are the flat planks of wood, between 5 and 15 feet long, butted end to end with tongue and groove joints.

- Everything is then tied together, this is done using coir string and rope which are called Pythons.
- The rudder and top deck is made from Teak or Mahogany.

The mast was traditionally made from Teak or Coconut and coir or sisal was used for the rope. Sails were made from Palm Leaves stitched together, more latterly they are made from a heavy-duty cotton like canvas which is between 400 – 500 grams/m^2. This construction method is still used today on the coast of Kenya.

2.2 Creating the plastic components

The core aim of this research was to find simple methods to construct a dhow using traditional craft techniques that have been developed over thousands of years and that are common methods found up and down the East African coast.

Everything was to be made locally in Kenya so the big challenge was to find collaborators with recycling facilities who could deliver quality materials, reliably! This was crucial for the production of the main components, the keel, the ribs, the rudder, the strakes and the decking.

Regeneration Africa in Malindi, was the closest plastic recycling manufacturer (200km) from the boatbuilding workspace in Lamu. Their business is focussed on the production of fencing posts and tiles used in the construction industry locally.

Initially they mixed all types of plastic (PET, PP, HDPE and LDPE) and sand into their products to make them harder and cheaper, which for building products is great.

Figure 4. Poor quality plastic, holes the sizes of Mango's and Oranges!

The initial results we received from Regeneration Africa however were not fit for purpose, the parts were heavy and stiff and not suitable for the application. There was also one additional major issue with this material, when the plastic was moulded into larger pieces, the moulding process produced huge air pockets, the size of mangos and oranges. When the boatbuilders used this material, huge holes appeared in the plastic rendering it unusable.

3 Testing and evaluation

The researchers needed to find out whether it would be possible to produce high enough quality material from the waste plastic found on Kenyan beaches and fit for the purpose of building a dhow.

The first challenge was to eliminate the presence of large bubbles in the recycled material, this needed to be addressed to create high quality parts using low-tech machinery.

3.1 Northumbria University testing – Stage 1

The researchers tested samples of the low-quality material using the following method.

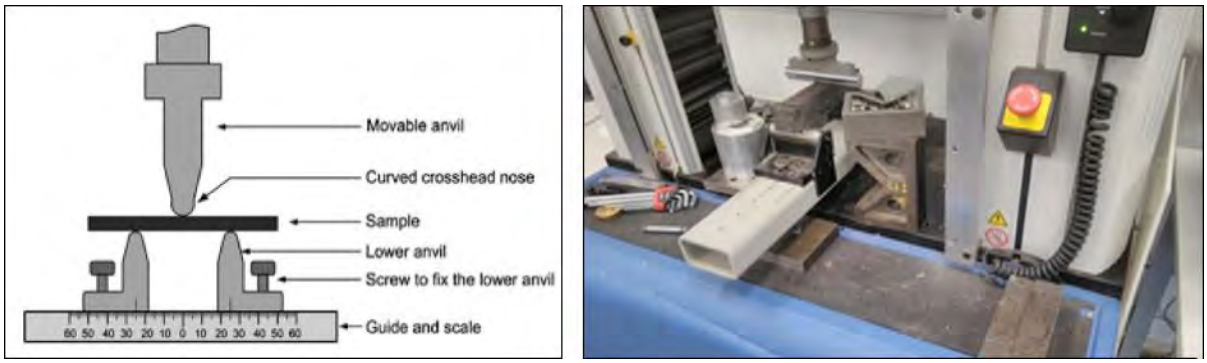

Figure 5. Images of testing at Northumbria University.

A rig was constructed using a simple three-point bending configuration; this allowed the flexural strength of a sample to be tested by measuring the applied force against deflection.

The equipment used for this experiment consisted an Instron 3300 Floor Model Universal Testing System, which was linked up to and interpreted using Instron Bluehill 2 Software.

The samples that were tested were all of the same dimension (300.00mm long, 28.00mm wide and 38.00mm tall) and they were evaluated against similar materials with known physical characteristics used in the construction of dhows.

Table 1. Results of sample testing.

	Yield Load (kN)	**Displacement** (mm)	**Flexural Strength** (MPa)
Hardwood	**7.550**	**11.21**	**70.02**
Softwood	**5.043**	**14.10**	**46.78**
Recycled Plastic Sample 1	**1.305**	**5.93**	**12.10**
Recycled Plastic Sample 2	**1.245**	**7.01**	**11.55**

The materials tested were significantly below the Flexural Strength required. The main reason as identified prior to the testing was the presence of the air pockets within the recycled material. The failures always originated from the holes that allowed cracks to permeate through the material.

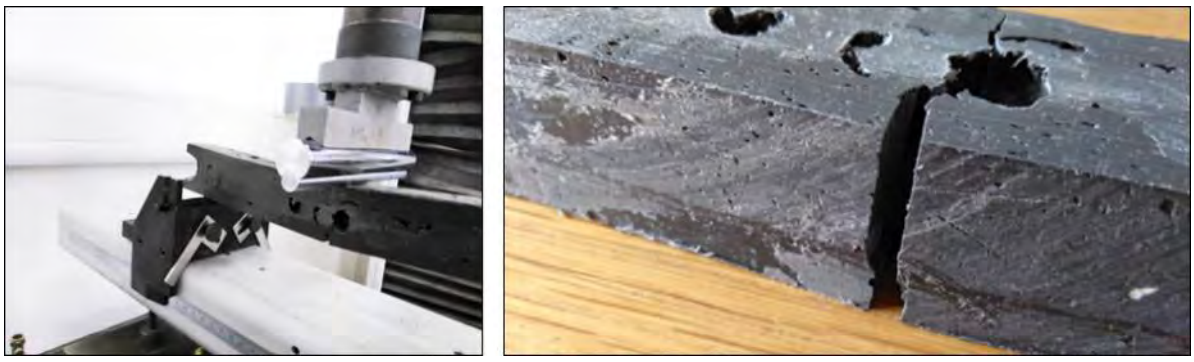

Figure 6. Cracks permeating through the sample material.

It was important to reduce the overall number of holes, but also to eliminate holes with sharp corners that caused stress concentration ultimately leading to failure in the material. This is the same characteristic that leads aircraft to have rounded windows. The bubbles and holes with sharp sides (shear) are caused from oil-based impurities within the material, the holes originate from outgassing of the molten plastic when cooling, containing humidity, the oil-based impurities come from the remaining waste particles within the plastic (paper, organics, wrappers, colour).

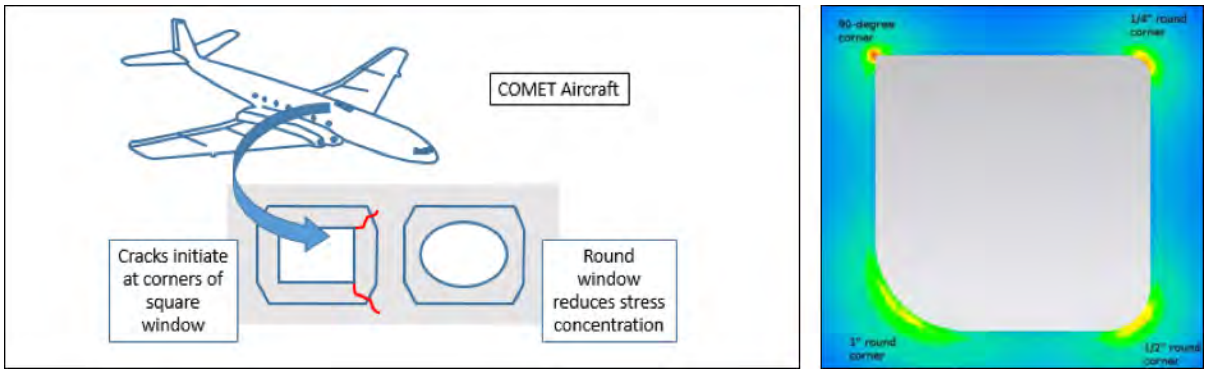

Figure 7. Square windows on planes were changed to round to reduce failure.

Another issue was the inconsistency of the material, it was heterogeneous and therefore the plastic tended to cool at different rates during the casting process. There were clear definitions between these areas causing skins to appear within the material and in doing so, creating areas of weakness. If the cooling of the material could be controlled then this would help with the overall strength of the material post production.

If the manufacturing process could be refined so that the consistency of the material could be made more homogenous (consistent) and the holes and bubbles significantly reduced then the Flexural Strength of the material could be increased substantially.

3.2 Processing recommendations

Observation and testing revealed that three aspects of the recycling process that needed to be addressed to reduce the shape, frequency and size of the air bubbles and increase the quality of the material:

1. **Sorting:** Sorting of different plastics so that similar polymers are used together.
2. **Cleaning/Drying:** Cleaning and drying of the plastic prior to melting to remove any impurities that cause the sharp air bubbles to appear.
3. **Casting:** Application of heat and pressure to create small regular air bubbles.

4 A refined process of recycling the waste

The researchers went about improving the recycling process by adding pre-sorting, cleaning and drying stages prior to melting the material, they also increased the pressure when the molten plastic was poured into the moulds and added heat to the outside of the moulds to get better consistency when the material cooled.

4.1 Pre-Sorting

Together with Regeneration Africa, the production methods were modified to use only a single type of plastic, Polyethylene. This plastic type could be easily identified though a very basic appreciation of production methods, in Kenya, PE and HDPE are blow moulded, lots of it washes up on the beaches and it can be easily sorted. The plastic that was collected was then shredded into small pieces before progressing to the next stage.

4.2 Cleaning and drying

The cleaning and drying process was highly controlled, initially the shredded plastic was washed, and rinsed thoroughly, it was then dried prior to being melted. This process was fundamental as it removed the organic and oil-based impurities that were still present in the waste plastic when collected.

Any organic and oil-based based impurities left within the plastic when it is melted are the main cause of holes and importantly holes with sharp corners in the finished material. The removal and control of such holes is fundamental in the production of consistent material with good mechanical properties for use in this context.

4.3 Casting

The molten liquid plastic is poured into moulds which are made from steel sheets that are welded together into shape to create each casting. When each mould is full of plastic, a top plate is put into position and pressed down with car jacks so that the material is held under pressure during cooling. The outside of the moulds are pre-heated and then cooled, this allows for a controlled cooling of the material throughout, any air bubbles left within the mould are also contained and are small and round with no sharp corners. This process creates uniform components with a high level of material consistency.

Figure 8. Images of sorting and the moulds used in the construction of the components.

5 The Results

By simple modification of processing methods, the researchers found that significantly higher quality material could be consistently produced. Because of it's Flexural Strength this higher grade recycled plastic material offers a wider range of valuable applications than were previously possible. This is helping to create greater demand for recycled plastic which because of its characteristics is sometimes the material of choice.

5.1 Material testing – Stage 2

The researchers carried out a second stage of testing using the new higher quality material at Northumbria University in May 2018. The results of the first tests in May 2017 gave baseline results of approximately 12.00MPa. The results from the second test provided results of up to 24.80MPa, an increase of over 100% in the Flexural Modulus of the recycled material. This meant that the researchers had succeeded in producing a recycled material fit for the construction of a sailing dhow.

Figure 9 shows that when the blockage is removed, the plastic material can flow back into the circular economy system instead of ending up as waste as was shown in figure 3.

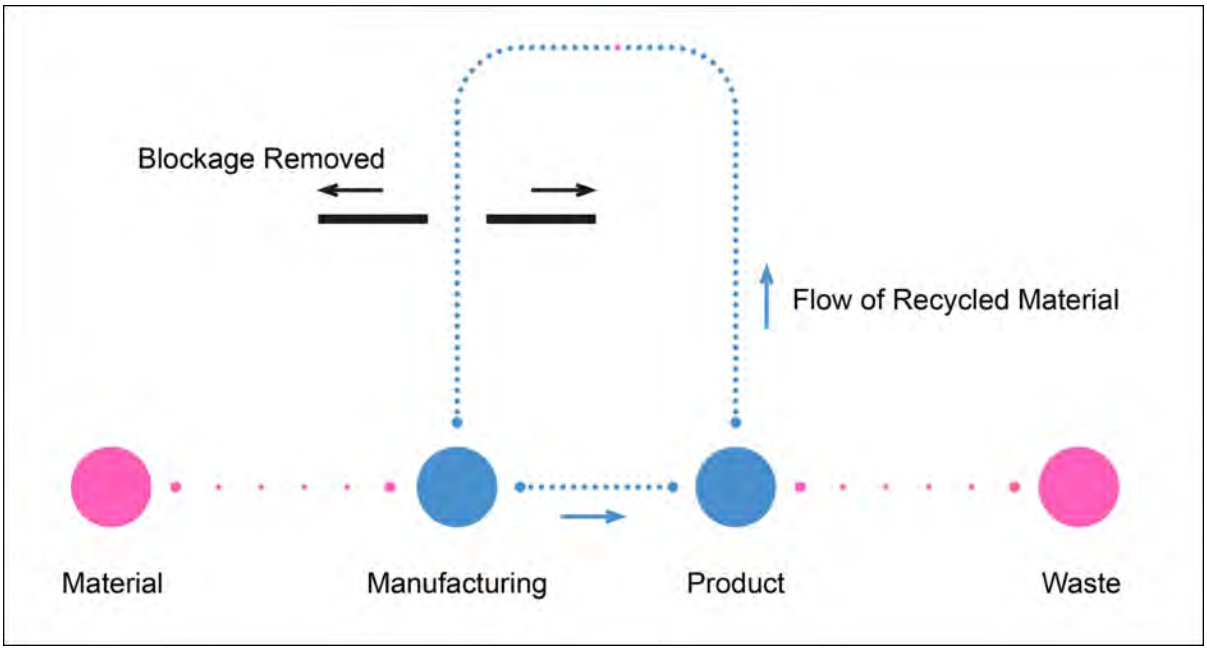

Figure 9. Unblocking in the Circular Economy.

Three technical challenges were solved and when used in combination, created a stable and suitable material for dhow manufacture, the three processes, when used locally in combination included:

1. **Sorting:** Careful sorting of the different plastics so that similar polymers were used together.
2. **Cleaning/Drying:** Cleaning and drying of the plastic prior to melting.
3. **Casting:** Control of heat and pressure to create structurally sound pieces of plastic.

5.2 The implementation, putting the materials into practice

The parts that were cast from the moulds were designed to be oversized, Ali Skanda (The Chief Boat Builder) and his team then used simple tools to craft the main moulded components (the keel, the ribs, the rudder, the strakes and the decking) into pieces that then were able to be fitted together.

Different moulds were produced for the keel, rudder and 6 different sized ribs (a number of boat ribs are produced from the same mould and the left and right sides are identical). There is also just one mould for the strakes as they are uniform and can be cut down to size during the final construction.

The integrity of the boat comes from the interlocking of the different components. Important areas were reinforced using stainless steel bolts, other components were made larger (thicker and wider) to compensate for this new material and its reduced mechanical strength when compared to wood.

The overall shape of the finished dhow was conventional but with a modified stern that helped with the stability of the vessel.


Figure 10. Images of the build process showing the internal structure.

Ribs were fitted to the main keel to create the skeleton of the dhow and over this were attached the strakes. To seal the hull, the dhow was filled with water, Ali and the construction team identified holes in the structure where the water leaked out. These holes were plugged with a mixture of cotton and tar which made the whole dhow watertight.

5.3 The Flip-Flop skin

The final process in the building of the Flipflopi Dogo was to make it look eye catching, this was done with the application of over 30,000 flip-flops collected from the beaches in Kenya. A local artist, Benson Gitari and his team sorted thousands of flip-flops, cut them up into regular sized pieces and glued them together to create large panels, which were then applied to the outer hull of the dhow.



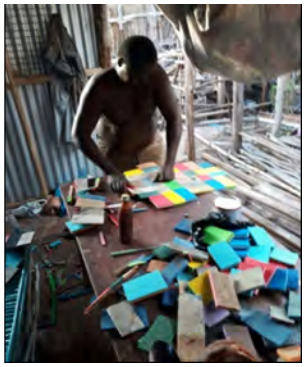

Figure 11. Images of the flipflop outer skin attached to the hull.

5.4 Seaworthiness

The Flipflopi gained seaworthiness approval from the following regulatory bodies:

- Kenya Maritime Authority,
- Kenya Ports Authority,
- Tanzania Maritime Authority and
- The Tanzania Ports Authority.

6 Impact of the research

The Flipflopi project team has pioneered new techniques to craft the various components used in the construction of the dhow. Every single element of the boat was constructed by hand and the dhow was finally clad in colourful sheets of recycled flipflops collected during beach clean-ups on Lamu's beaches.

For hundreds of years Mangrove wood has been used to craft the ribs of sailing dhows however this material is now banned globally because of damage to the vast and varied natural habitats created by mangroves.

Through this research project a new high grade, locally produced recycled plastic is providing a sustainable alternative to the traditional materials used in dhow building. This high-grade recycled plastic is a good substitute for the wood of the Mangrove tree, it brings with it many additional properties and offers a valuable second (and hopefully longer) life for waste plastic that would otherwise litter the shores of East Africa.

7 The Flipflopi Expedition Project impact

Through the building of the dhow using recycled plastic, the project was able to create the following impact during its first expedition:

- The dhow was launched in late 2018 in Lamu and the Project partnered with UN Environment's Clean Seas campaign, which engages governments, the public and the private sector in the fight against marine plastic pollution.
- The partnership of the Flipflopi Project with the UN Environment was key to enable them to engage international decision makers on the environment to activate real change beyond the expedition.
- The 16 strong expedition team travelled 500km in two weeks from Lamu (Kenya) to Zanzibar (Tanzania) at the end of January 2019. They stopped at 12 different coastal communities en route and communicated their message to over 10,000 that met them on the beaches including over 3,000 schoolchildren and 50 local conservation and ecotourism organisations.
- During the two-week voyage, they reached a worldwide audience of over 850 million via media coverage and appeared in over 200 media articles and features in over 30 languages across the world.
- 40 East African businesses pledged to ban the sale of single-use plastic bottles/straws and one Kenyan county government immediately committed to close down its biggest dumpsite.
- During the 500km, all of the team took part in collecting over 120 water samples to test for Micro-Plastics and Micro-Fiber's, they developed simple tools and techniques for analysis and shared this data with the wider scientific community.

Figure 12. Images of the school children and Mr Siim Kiisler onboard the Flipflopi.

In Zanzibar, the team was honoured to be joined by the President of the United Nations Environment Assembly, Mr Siim Kiisler commented that "The Clean Seas - Flipflopi Expedition inspires citizens from Africa and around the world to become more aware of one of the most urgent environmental issues that we face".

Following the completion of the Clean Seas expedition, the Flipflopi boat was the centre piece exhibit at the UN Environment Assembly, in Nairobi Kenya (11th to 15th March 2019), a forum that brought together more than 150 ministers of environment. The assembly is the world's highest-level decision-making body on the environment.

7.1 Further research

The researchers are working to further refine the waste plastic recycling processes described in this paper. This will enable the production of a large ocean-going dhow that will travel from Lamu in Kenya to Cape Town in South Africa in 2021.

Additionally, further work is being undertaken to explore how these techniques and methods can be applied to other areas of dhow production such as the sail and mast. Work is also being carried out to embed these processes into the dhow making industry and to explore the use of recycled plastic as a material for boat repairs.

7.2 The big picture

It should be noted that the innovative construction of the dhow only highlights a limited level at which the success of traditional design interventions can be judged in that it impacts on an existing situation rather than addressing the root cause of a global waste problem. Whilst the boat building project is raising awareness of the pressing need for the adoption of sustainable practices, the growth of a circular economy requires the enrolment of all stakeholders worldwide, as Martinez and English (Martinez, 2015) find “the key to a fundamental change in approach does not reside solely with designers” however “the use of relational and systems thinking tools to facilitate sustainable design throughout business and society, could prove to be far more valuable and effective”.

The build of the dhow only acts as a tangible vessel for spreading the core message of the project, the overriding vision for the collaboration between The Flipflopi Project and the UN Environment’s Clean Seas campaign is to raise awareness of the value in the materials we use every day and provide a platform and opportunity for significant change to be made by engaging all stakeholders, raising awareness of the circular economy throughout the global community, which in turn would prevent the plastics from entering the oceans in the first place.

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DESIGN IS GLOBAL AND MULTICULTURAL YET DEBATES HAVE FOR A LONG TIME BIASED PARTICULAR MINDSETS, IDEOLOGIES AND PHILOSOPHIES. WHILE THERE ARE VOICES THAT CLAIM THAT DESIGN IS INCLUSIVE, REALITIES HAVE TENDED TO SUPPORT EXISTING NOTIONS OF POWER AND HIERARCHAL SOCIO-POLITICAL SYSTEMS. HOW CAN DESIGN BECOME MORE INCLUSIVE, ETHICAL AND SUSTAINABLE? HAS THE TIME COME FOR THE DECOLONISATION OF DESIGN? WHAT ARE THE ETHICAL CHALLENGES THAT DESIGN MUST ADDRESS AND HOW SHOULD THEY ADDRESS IT?

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Co-designing for social inclusion of young people in mental healthcare: reflections on challenges and alternative care models

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This paper is a reflection on a one-year research project that has been experimenting with an educational format linked to a compulsory job training programme for Italian high school students. In the project a mix of young people suffering from early psychosis and few high school students were engaged in a typical co-design process and trained in the application of a set of co-design methods and tools to re-imagine the future of a neglected green area, which used to be the agricultural colony of an ex-psychiatric asylum. The combination of different factors – the co-design training, the focus on age-appropriate and concrete design objects and activities, the engagement of caregivers and strategic local actors and the location by non-clinical facilities – have been critical to foster social inclusion and address the existing barriers toward a meaningful participation of young people for mental healthcare.

Keywords: mental healthcare, youth inclusion, service design, co-design

1 Introduction

1.1 Youth Inclusion and Mental Health

As stated by Patel et al. (2007), a global consensus in mental healthcare studies identifies young people, aged between 12 and 24, as the ones dealing with issues such as the acquisition of a role in the society, the establishment of key relationships and the building up of a personal autonomy (Kane & Bibby, 2018). Youth is when most of mental disorders appear even if they are generally noticed later in life (Patel et al., 2007). According to WHO more than 10% of adolescents in Europe have some form of mental health problem, “neuropsychiatric conditions being the leading cause of disability in young people” (WHO, 2014:2). Notwithstanding the awareness of the weight of mental health disorders in youth today “when help is sought, it is either not available or is typically offered in settings that fail to engage the young person and their family and to deliver effective help” (Patel et al., 2007:1308); this is also due to the fragmented delivery systems in the transition from child to adult care (Mulvale, Miatello & Mulvale, 2016).

Moreover, the fact that early psychosis appears in a crucial age where young people are dealing with “life-defining experiences” (Kane & Bibby, 2018) makes the recognition of a mental health distress very difficult and controversial. Flexible and informal ways of

approaching young people are said to be more effective than the ones traditionally adopted by adults' mental health services: in fact, community services need to be "age-appropriate and competent to offer early intervention and continuing support to young people with a first episode of a severe mental health problem" (WHO, 2013: 10).

This perspective also implies looking outside services and linking with other sectors like schools, encouraging activities of nongovernmental bodies (Bertolote & McGorry, 2005) to establish a service mix that works as "a supportive system for self-development and social integration" (UN, 2014: 32).

Given this scenario, this paper reports on a one-year project experience exploring how service design could help addressing this call for youth-friendly solutions and settings for young people with early psychosis in collaboration with an Italian Department of Mental Health. After introducing service design for mental healthcare, the paper summarises the project experience to then reflect on the key challenges and possible strategies adopted to foster meaningful participation of young people toward alternative models of care and propose co-design process itself as a valuable approach to enhance social inclusion.

1.2 Service Design and Mental Healthcare

Service design is a human-centred, creative and iterative approach to service innovation (Meroni & Sangiorgi, 2011) that puts people at the centre and as partners of co-design processes. Designing for mental healthcare is an emerging and promising area, as human-centred and participatory approaches are recognised as valuable ways to address complex challenges. Experiences are developing of applying service design to re-imagine existing mental healthcare services (Anderson, Nasr & Rayburn, 2018), orient organisations toward Recovery (Carrera, Sangiorgi, Foglieni, Segato, & Lucchi, 2018), and to build design capabilities in organizations (Pierri, Warwick, & Garber, 2016).

A particular interest has been given recently to youth mental healthcare services, given the recognised "failure of traditional methodological approaches to engage young people in ways meaningful to them" (Nakarada-Kordic, Hayes, Reay, Corbet & Chan, 2017: 230). In this area, the application of participatory design approaches with young people experiencing psychosis is a novelty. A first review of design research work conducted with children and youth with mental health issues has revealed how co-design approaches have helped to give voice to young people through the use of visual media (Mulvale, Miatello & Mulvale, 2016). As an example, 'Aye Mind' – a service design project developed by Snook in partnership with Greater Glasgow and Clyde NHS, the Mental Health Foundation and Young Scot - worked to improve the wellbeing of young people by making better use of the Internet, social media and mobile technologies. These experiences are demonstrating the feasibility to engage young people to improve service provisions to respond to their needs and preferences; with this article we are interested in how co-design processes themselves can become a mean for social inclusion and inform alternative models of care.

2 The project

In the Italian landscape, national interventions on early psychosis appear fragmented and not very active compared to other European and non-European countries, with few successful independent local experiences such as "Programma 2000" - a "multi-modal protocol of early intervention in psychosis, set up in Milan in 1999" (Cocchi et al, 2008).

Lately two main national guidelines have been given to orient youth mental healthcare:
1. Integrated and inter-institutional (school, healthcare and welfare services) strategies to value and promote personal capacities of young people, in terms of self-confidence, auto efficacy and resilience;
2. Definition of treatment paths for the early intervention for young people in pre-adolescence, adolescence and youth age in risk of mental health distresses (Ministero della Salute, 2013).

The action-research project, belonging to the first national guideline, involved a design research team from an Italian university, one psychologist from the local Mental Health Department (MHD) and one psychologist from an ONG association of mental healthcare family members. The aim of the project was to engage young people, aged from 17 to 23 y.o., in a co-design process responding to the need for age-appropriate initiatives that should support both self-development and social integration. In the project set-up stage, the team decided to focus the co-design process on a neglected green area - that had already been used for other rehabilitation initiatives by the local Mental Health Department. Being that this area is close to two local high schools, the team decided to engage high school students, taking advantage of a compulsory job training programme called “Alternanza scuola-lavoro”[1].

As a result, the project run from October 2017 to June 2018, involving 3 young patients of the community mental health centre, 1 young patient of a social cooperative and 3 high school students. Given the vulnerability of young patients, the psychologists operated as mediator and validator of the approach, carefully choosing and introducing patients to the project and consent forms, and valuing time by time the feasibility and modality of their participation. Anonymity for external communication was guaranteed while equality in the set-up of teams and activities was a priority. Participants - supported by the design team, two psychologists and a set of local actors (e.g. an agronomist, an actor, a gardener, a librarian, a food delivery service provider, and a musician) - followed a typical design process which included the following steps:

1. Set-up: defining the design intervention
2. Explore: mapping the context
3. Generate: envisioning future scenarios
4. Develop: sharing future scenarios

2.1 Explore: mapping the context

The project started with an exploration phase where young participants were introduced to design principles and to some desk and field research methods. The first activity consisted in the collection – done by students - of 31 case studies regarding different uses of green areas from the local territory and abroad. Moving from the desk to the field, participants were then introduced to the interview method, co-developing an interview guide to talk with their peers and explore their experiences, habits and values regarding open air activities. A total of 27 interviews were led by students and the design team. In a following phase the data collected were analysed and clustered in a collaborative session to define 7 persona profiles; young

[1] The programme is an integration to the teaching path that - through practical experience - helps to consolidate the knowledge acquired at school and to test the attitudes of students in the job field. The programme is regulated by the Italian law 107/2015 (*La Buona Scuola*).

participants were also trained to the basics of an open source graphic software to understand the work needed in visualising data from a design research.

A first co-design workshop (see Figure 1) was organized involving 18 participants - including young participants, caregivers and local experts - to envision new scenarios for the green area, starting from key themes emerged from preliminary meetings with local key actors. The collaborative session was supported by some co-design tools, all created by the design team with the constant collection of participants' opinions: inspirational cards representing collected case studies, persona profiles, offering maps and activity cards to support the creation of scenarios. Emerged ideas included: the creation of a permanent laboratory of practical activities related to cultivation; a multifunctional centre with rehearsal room for musical and theatre groups and pop-up stands for the realization of exhibitions, workshops and training courses; thematic paths linked to the exploration of emotions through artistic installations, readings, audiobooks and various initiatives.

Figure 1. First co-design workshop

2.2 Generate: envisioning future scenarios

The following generative stage started with a field activity, conducted by the design research team, visiting 5 best practices of community hubs associated with green areas that were studied in terms of their business and management models. Inspired by these concrete cases, students were asked to visualise their ideas for the park using sketches (see Figure 2) and mood boards. These desk activities were integrated with some field research in the park mapping the presence of trees and other elements.

As a result, a second workshop developed initial scenarios to explore sustainable business models for the green area and to design more detailed spaces and functions. 16 participants - including young participants, caregivers and local experts - envisioned their ideas supported by co-design tools such as cards showing innovative case studies of management models and format to support scenario visualisations.

Figure 2. Scenarios sketching session

2.3 Develop: sharing future scenarios

The last stage of the process focused on visualizing new ideas and scenarios for the park emerged from the previous steps. Participants created a wood scale model of the park (see figure 3) with the support of the local FabLab who introduced students to the practice of 3D modelling and laser cutting during a lesson held in their premises.

Figure 3. Scale model assembling

Scenarios from the second workshop were translated by participants into detailed storyboards and the scale model became the set for a photo shooting session (see Figure 4). The resulting set of photos were then assembled in a post-production phase by the design research team to create two stop-motion videos which were presented to selected guests invited to the final event of the project. During this last phase a short collective evaluation session, facilitated by the two psychologists, was also held to collect participants'

opinions, given the difficulties faced in asking young students and patients for individual feedbacks.

Figure 4. Photo shooting for stop motion

3 Reflections on the process and the emerging care model

This co-design process faced some limitations and challenges, but it offered the opportunity to reflect on an alternative model of caring for young people in the Italian landscape. In particular, the co-design process and training format seemed to address some of the key challenges by providing age-appropriate and engaging initiatives, favouring social integration in attractive non-clinical facilities.

3.1 Meaningful participation: self-development and age-appropriate activities

Establishing the programme as a co-design process helped to focus on capabilities, e.g. collaboration, experimentation, imagination, empathy and visualisation, building-up new skills and competences that could be valued as an opportunity for self-development. As confirmed by participants, the project helped them discover new techniques and methods, which were very distant from their training and past experiences. Nevertheless, some difficulties in teaching the design process to non-experts emerged, having to adapt exercises to their existing skills and time limitations.

To respond to this the project attempted to focus on a concrete design object with the real potential of being tested and implemented. Tangibility - combined with the choice of specific skills that could result attractive such as 3D modelling, photo shooting and video making - was felt crucial to develop commitment and motivation in participants as a high school student pointed out: ‘To focus on the redevelopment of a disused space motivated me to actively participate in the proposed activities’.

3.2 Continuity of participation: intermediation and time concerns

A general problem in co-designing with a vulnerable population and in particular with mental healthcare users sees the health status as a strong influence on participants’ ability to stay involved in the design process (Mulvale, Miatello & Mulvale, 2016). Discontinuity of

adolescents in their willingness or ability to engage in the activities of a long project was critical demanding for some extra effort by the design team in leading the training sessions and taking over some preparatory work, with the risk of dropping the level of participants' engagement. Finding a balance between design led and participants' led activities remained controversial. Fundamental to tackle the participation issue was the presence of 'intermediaries' (psychologists) that constantly monitored the young people motivating and supporting their participation, while adjusting the activities to the up and downs of their engagement.

3.3 Social inclusion: a community multidisciplinary effort outside clinical settings

Setting an inclusive co-design process which involved local actors and resources together with the young participants enriched the educational scope. The project gave young people the possibility to get in contact with unknown local facilities and places beyond adult mental healthcare facilities. They had classes in the premises of a science centre dedicated to environmental sustainability, visited the local FabLab to learn how to design a scale model, doing a graphic design class in the computer lab of a high school. Ensuring the variety and quality of places in which the design activities took place and bringing the young participants out of mental health premises, while interacting with other young people from the schools, stimulated their willingness of experimenting themselves with new tools and capabilities.

At the same time having to deal with a real context which involved different stakeholders and the managing association, caused the interference of political interests requiring some adjustments; the project team therefore experienced the tension "between creating enthusiasm for the work that will motivate engagement, versus the risk of raising expectations of service change that may not be realized" (Mulvale, Miatello & Mulvale, 2016:124).

4 Conclusions

The project helped to explore the encounter between different interests: ensure a rich educational programme to the high school students and an occasion for mental healthcare services to re-design their offer in order to maintain young people engaged and foster social inclusion.

We suggest that co-designing with young people with early psychosis with other young people and local actors, on common topics of interest and within non-clinical facilities can represent an effective way to stimulate engagement and participation, and represent an alternative model of care in community settings. For this reason, the identification of existing opportunities in the legislation and in the territory (e.g. the school programme) is crucial. The project proved how a preliminary phase of mapping the existing opportunities of a specific territory and sharing visions on how to actively involve key actors in the process was fundamental to build a real opportunity within the local context.

Also, the project highlighted how the lack of continuity and commitment could lead to a partial failure of some stages of the co-design process (and the mental healthcare provision too). In fact, as a psychologist commented: 'It was difficult to explain to the absents the progress we made and to reintegrate them in the group'. In this sense identifying some easy to access short-term tasks - compatible with different level of readiness and participation - and concrete activities with tangible design outputs, while reducing or compacting the overall length of the process, could strengthen the impact of this approach.

Finally, the project illustrated how co-design can play multiple roles in mental healthcare – supporting self-development, service innovation, and social integration - becoming a gradual support model for more inclusive mental healthcare interventions that are integrated with the local community.

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Curatorial Groupware: Designing Collaborative Curation Tools for Public Exhibition of Community-Built Archives

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This paper discusses the design and production of a groupware tool as a method for advancing a larger interdisciplinary research collaboration. Groupware is defined here as software enabling real-time collaboration. In this case study, the digital tool is being designed to facilitate participatory design through remote collaboration. Community participants and interdisciplinary researchers in multiple locations will use this groupware tool to remotely and collaboratively design venue-specific installations from a community-built archive. Each installation of the archive can be designed specifically to the contextual, historical, and local conditions of the venue itself, as determined by the community participants. The collaborative efficacy of user-centered design for the production of groupware is cast in relation to participatory methods (and mindsets) using the case study of History Moves, a research collaborative at the intersection of public history and participatory design. As the History Moves team prepares a nationally touring exhibition of an oral history project called "A Women's History of HIV in America," the design of custom—but extensible—groupware for collaborative curation extends the participatory scope of the project. The voices of the over 40 participating women—from disparate social geographies of Chicago, Brooklyn, and North Carolina—are represented at multiple touchpoints in the process, through the sharing of their narratives, participation in the construction of an archive of their materials, and now the design of a collaborative curation tool. The collaborative curation groupware expands the participants' agency to self-represent through curating unique exhibitions at distinct venues. This approach to the decolonization of design aims to expand the scope of the project's broader participatory model and enact advocacy through local programming that directly involves the participating women.

Keywords: Collaborative curation • Participatory design • Exhibition design • Remote collaboration • Groupware design

1 Background

Exhibitions are thematic public displays of information, curated to visually and tangibly represent a notable point of view. Historical archives, contemporary concepts, and future speculations are thus publicly presented to transcend their moment while also producing new sites for critical discourse. Exhibition design and associated programming comprise an interdisciplinary process, which presents challenges of coordination and pre-requisites the capacity to co-design. The diversity of skills and their relevance to individual exhibitions

makes exhibition designers accustomed to working in project-oriented multi-disciplinary teams (Hammond & Waite, 2010). The following section illustrates some of these challenges through an ongoing case study, originally piloted through local exhibitions in 2016, and now working toward broader implementation in 2020.

1.1 History Moves: An oral history of women with HIV in America

History Moves is a research collaborative led by a public historian and a graphic designer who partner with topically-connected communities with limited representation in and access to the construction of public narratives. As a platform for participatory projects, History Moves brings together historians, designers, and community-based organizations to produce public history forged in participatory engagement. The goal is to make public historical narratives *more participatory* and *more engaging* than those enacted by experts alone. By synthesizing methods from both public history and participatory design, the collection, curation, design, production, and study of public histories are undertaken in a hybrid historical-design process. This process engages contemporary publics in producing substantive community responses to pressing contemporary political issues.

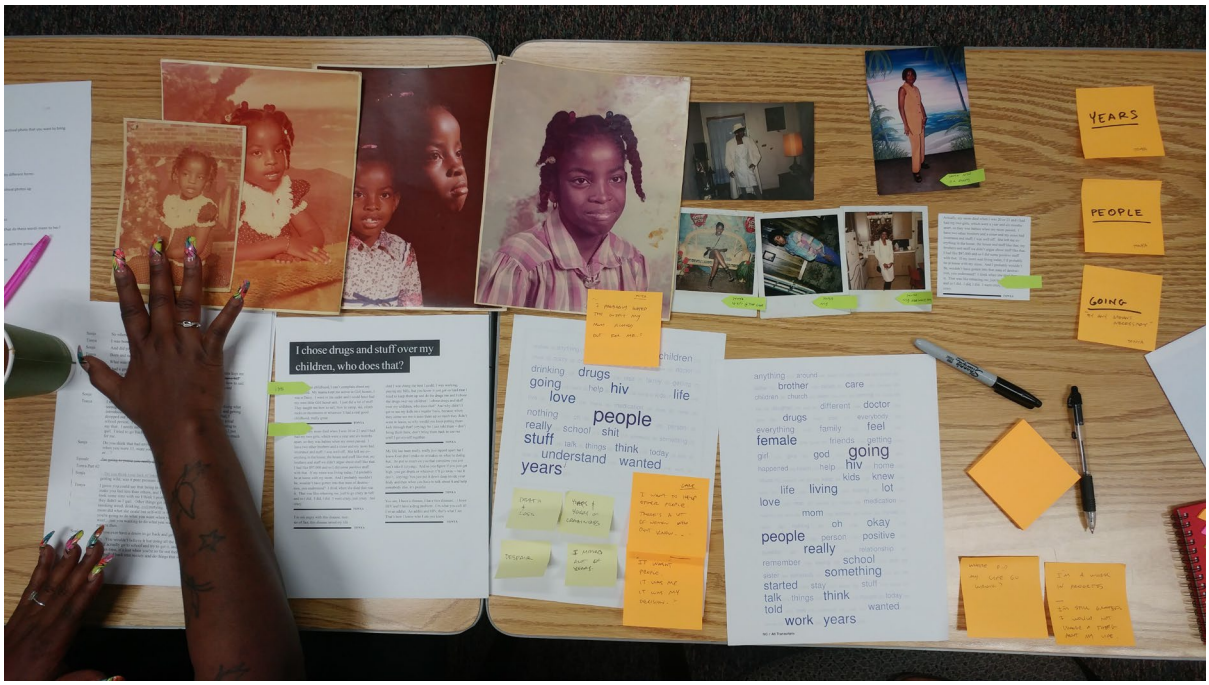

Figure 1. Participatory editing and curation workshop, North Carolina, 2017

Since 2014, the History Moves research collaborative has worked with over forty women living with HIV in three locations from across the United States: Brooklyn, Chicago, and North Carolina. These women are all participants in the Women's Interagency HIV Study (WIHS), a multi-site longitudinal study "to investigate the progression of HIV disease in women" (Bloomberg, 2017) The study was started by Johns Hopkins Hospital in 1993 and is the largest ongoing longitudinal study of women with and at risk for HIV in the United States.

This process began with collecting oral histories and develops into production and dissemination of public media that present collectively determined narratives about the past, present and future. There has been a deliberate focus on mobile, physical exhibitions with the aim of articulating *mobility* beyond that of digital media. By touring mobile exhibitions of this material, the social boundaries of urban spaces are transgressed, physical spaces and environments are transformed, and new sites and audiences are produced for informed

dialogue on the ongoing risks, challenges, and stories of surviving HIV/AIDS in the 21st century. Cultural theorist Paula Treichler states that in order to form a definition of HIV/AIDS that will govern policies, regulations and rules must 'rest upon the deeply entrenched cultural narratives' of those living positive. What AIDS signifies must be democratically determined (Treichler, 1987).

1.2 Designing curatorial groupware

Curation in the contemporary context refers most often to the preservation, organization, and interpretation activities of a museum, a gallery, or other types of collections for the public to see. It is the act of 'selecting, organizing, and presenting (online content, merchandise, information, etc.), typically using professional or expert knowledge' (Oxford Dictionary definition). However, the word "curate" originated from the Latin word 'cura' which translates as 'care, concern, attention, management'. This fundamental understanding of the term establishes the relationship between the curator and the exhibit itself, to be grounded in care and mindful representation. The participatory design model employed to develop History Moves thus far, personifies intentional, mindful representation in that it stresses the participation of community participants—in this case, American women living with HIV—as empowered decision-makers throughout the process from collection to curation to public display. Unlike co-design, that gathers user insights which may or may not translate to viable design outcomes (Trischler, Pervan, Kelly, & Scott, 2017), the participatory model seeks community inputs at multiple sequential phases, which are highly iterative and collaborative in nature. It views the "users" not just as content experts–the ones with the most knowledge about what they do and what they need–or potential consumers. Instead, they are partners in design and technical direction (Namioka, Schuler, 1993).

Currently, the History Moves team is working on the design, production, and programming for a nationally touring exhibition to combine narratives of all participating women from Chicago, Brooklyn, and North Carolina. New tools and workflows are necessary to achieve the project's aim at expanding its participatory model for not only collecting, but also interpreting, publicly presenting, and generating active and local discourse on relevant contemporary social topics.

To achieve this goal—and fill a gap in the landscape of easily accessible tools for community-engaged research—the team is now designing and producing a "collaborative curation" tool, designed to facilitate participatory processes that will allow each venue the exhibition visits to be uniquely curated and designed with direct input from the community participants (in this case, participating women from the respective US geographies). "Groupware" describes software, tools, process, and/or programs that enable real-time synchronous collaboration (Podgorny, Walczak, Warner, & Fox, 1998). In this case, the groupware tool is being designed to facilitate participatory design and curation through remote collaboration between researchers and participants.

While this groupware is uniquely designed for the specific conditions of this particular archive and its parameters, the goal—and impetus for this article—is to conceive this groupware tool as a model for similar community-engaged projects. While custom, the general functions and user experience of this groupware can be made extensible for interdisciplinary research teams working in similar community-engaged contexts, in which there is a desire to publicly disseminate community-built archives in a fully participatory manner.

The process this groupware enables has three primary stages.

1.2.1 Site Visit

Exhibit curation is initiated by visiting different sites to identify and document the unique capacities of each venue. The site visit is simply generative and can be discipline agnostic. For instance, a member from the research team, a local clinician participating in the project, or one of the engaged community participants could fulfill this function. An inspection of the venue is structured to record its spatial measurements, accommodative capacity, details of the location including neighborhood insights, demographics, and history, as well as interior specifications. This data feeds the groupware with floorplans along with geographical, visual, and empirical data to aid in planning. Any existing local knowledge, such as the neighborhood, venue history, regular audiences, etc., are also collected to initiate curatorial discussion.

1.2.2 Collaborative Curation, Design, and Programming

The inbuilt data on the tool is tagged with identifiers of location, neighborhood, type of data (photograph or verbatim, static or interactive) that help classify and filter the artifacts, in this case, a series of dozens of unique “posters”—each containing several previously aggregated excerpts of oral histories, personal or archival imagery, or local historical context—for each venue and the exhibit configurations it allows.

Once the content elements (posters) are selected, filtered and sorted by type, this content is assembled in the curator’s library, which can be revisited with a quick action (Fig 3.) The content that is left unselected is also carried forward, but rests at the bottom of the library in a separately identifiable pile that can be accessed at any time. These decisions were made keeping in mind the agile nature of collaborative projects, where this dynamism facilitates rapid iteration. Taking into consideration the iterative process of designing the panels, the tool allows the curator to select a greater variety of content even though the site visits quantify the capacity of the venue.

The curation of the exhibition panels will simulate a walkthrough on a path through the selected floorplan. The design of each panel will be visualized individually, pairing posters in sets of four, static or interactive, which can be configured in multiple ways through simple drag and drop interactions (Fig 6.). The sequential movement from one panel to the other establishes an intended sequence of viewing the exhibition, helping the curatorial team of researchers and participants to build a step by step narrative.

Programming community-engaged events—also specific to each venue—is critical to producing new sites and audiences for discourse. The context-specificity of the exhibition contents and design, enabled and executed by the design of the groupware, is extended by context and venue specific programming. Speaking events, symposia, workshops, tours, and even informal but organized discussions not only generate substantive local discourse, they also produce new opportunities for community participants to translate their personal experiences into expertise, operating as docents, lecturers, and facilitators.

Planning for a robust programming schedule at each venue is facilitated by the groupware. Proposed events can not only be accessed and acted upon by multiple collaborators but are also stored in the knowledge base for incremental development. This living archive preserves and expands on the possibilities of the venue, creating a package file as an outcome that stores both the context-specific content curation as well as the programming. This feeds into future work as an advanced vantage point each time when designing within similar contexts which might have overlaps in venue, content, or program planning.

Any given work session may have participants working in three or more physical locations. A new session ID at the beginning of each curatorial or programming planning session keeps track of who participated on the project, with fields to input insights on the group's discussion and decision-making. For example, in this case study, some participants wish to retain anonymity so the physical proximity of any given exhibition to their place of residence may be one very important factor for curatorial consideration. This real-time synchronization would mimic the natural ways of everyday communication and vastly improve future work efficiency. The tool relays instructions that can be executed by the team using a user-centered design methodology.

1.2.3 Implementation of Collaboratively Curated Plans

After a city's multiple venues have been collaboratively curated and programming plans initiated, the tool produces documents and workflows that assign follow-up tasks to the team. Group content selections are applied to elevation drawings, and data sets of the required components (including digital audio files and physical posters) are produced. These venue specific components are then attached to a generic set of installation instructions for assembly of the exhibitory, which can be distributed to the installation team at each site. The group's decisions about event programming are similarly captured and distributed to team members for planning, confirmation, and implementation. In this workflow, the collaborative planning activities catalyse and organize the work of implementing each venue's installation and programming.

2 Methods: User-Centred Design in service to Participatory Design

History Moves begins its projects with oral history, uses hybrid participatory design/public history methods to interpret collected narratives, and then translates (aggregates) those collective narratives into public-facing media, including books, short films, digital publications, archive interfaces, and mobile exhibitions (Wizinsky, 2019). In this process, the participating women transformed their roles from anonymous subjects of medical study into a network of agents actively shaping their own historical narratives—from anonymity to authorship.

Figure 2. Manual curation process of the exhibition

In order to for the exhibition to be mobile and remotely curated, a team of designers and digital humanists are designing and developing a digital collaborative curation tool. Currently developing as a tablet app, this tool facilitates and visualizes the curation of the exhibition by the participating women. The tool is being developed in the form of wireframes with structural specificity that drives functionality even without the content itself. Dozens of modular “posters” (printed content) with images or quotations from the oral history interviews comprise the primary content of the modular exhibition design. Some of these posters use conductive inks connected to micro-processors to allow for touch-activated audio playback. The database of posters, audio files, and related metadata comprise the central archive planning tool at the back end of the curatorial groupware.

The design and development of the collaborative curation tool is a joint effort between designers and design researchers from History Moves and faculty, students, and staff from the University of Cincinnati Digital Scholarship Center (DSC). The DSC is a catalyst for collaborative, trans-disciplinary forms of research and teaching. The DSC brings together humanistic methods and technical innovations to test paradigms and create new knowledge between disciplines. Faculty, students and staff with specialties in Digital Humanities, Computer Sciences, and Library Sciences collaborated with design faculty and students in conceptualizing and developing the tool and workflow, making for a fully hybrid, trans-disciplinary experience.

3 Results: Task Flows, Wireframes, and User Testing

Design researchers engaged in the project have developed a workflow for the app, annotated wireframes, and an (in progress) interface design which will be developed by a team of students and faculty organized by the University of Cincinnati DSC. The focus is on democratizing the user experience, as the users will be interdisciplinary, mostly not exhibition designers. User journey maps have been developed and tested, to be taken in the field for usability testing with participating women and clinicians. Developed sections of the groupware app will be evaluated as well, through usability tests aimed at universally efficient information architecture.

In order to keep up the project’s participatory values, usability goals are oriented towards real-time collaboration, effective visualization, and true modularity as the determinants of the features of the first version. The user-centered approach is employed here in service to the project’s broader participatory framework, which is to build the groupware with the participating women and with features that empower them and other non-design stakeholders to voice their opinions in the collaborative process.

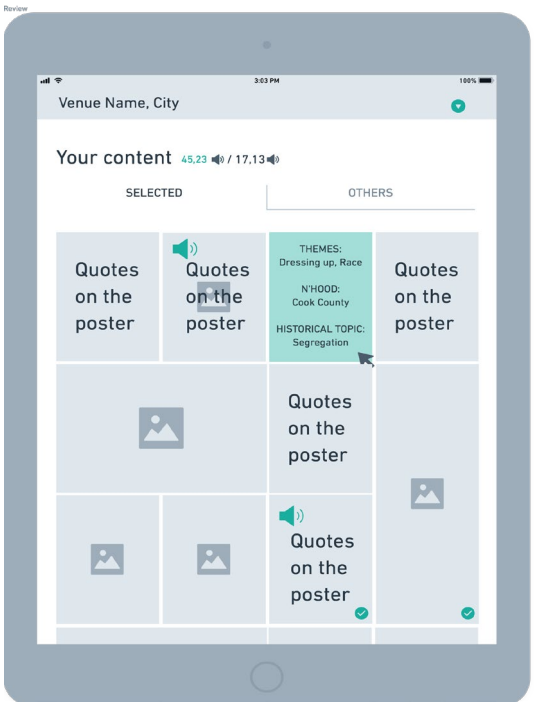

Figure 3. Wireframe of the content review

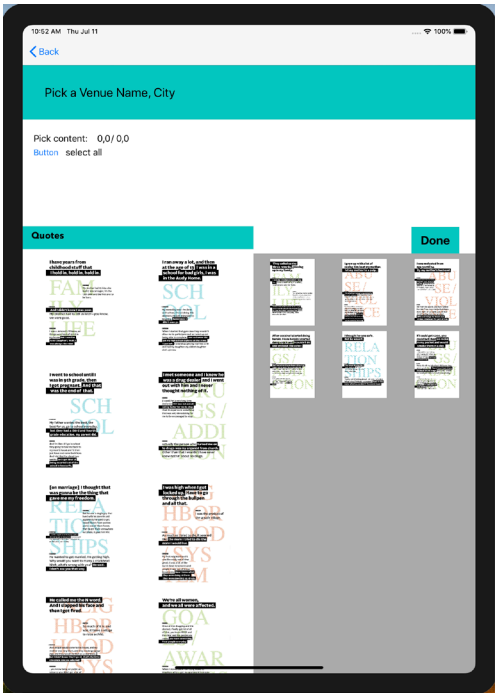

Figure 4. Prototype of the filtering process

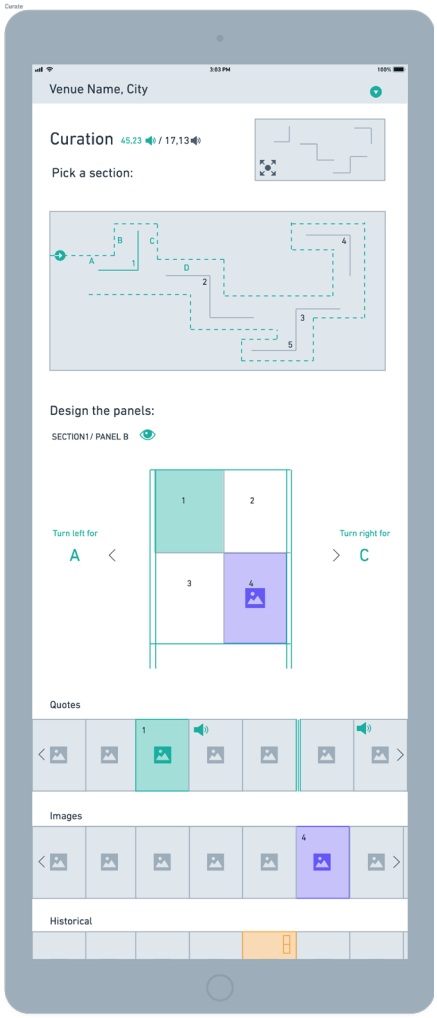

Figure 5. Wireframe of the curation screen

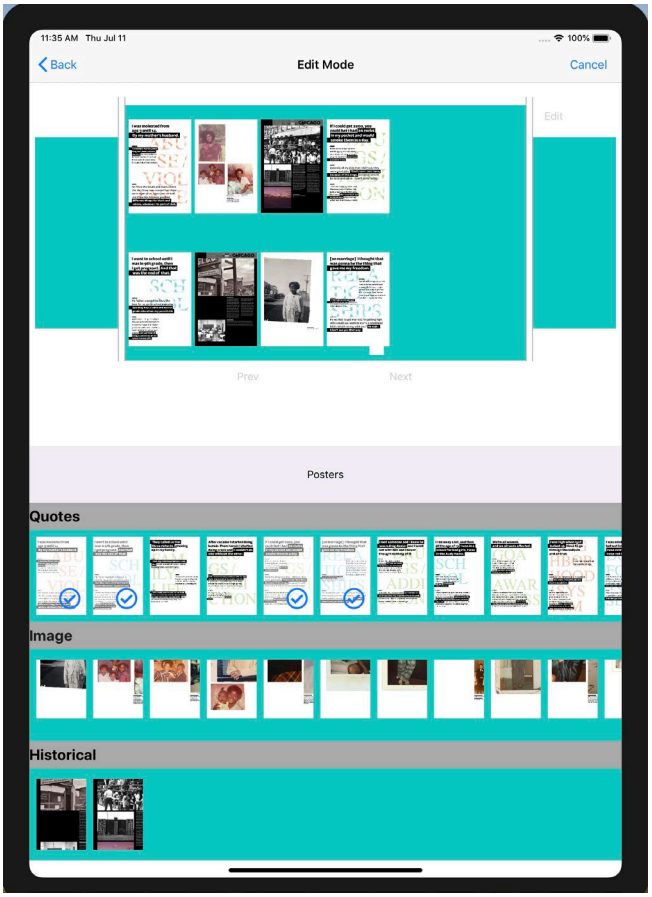

Figure 6. Functional prototype of curation screen

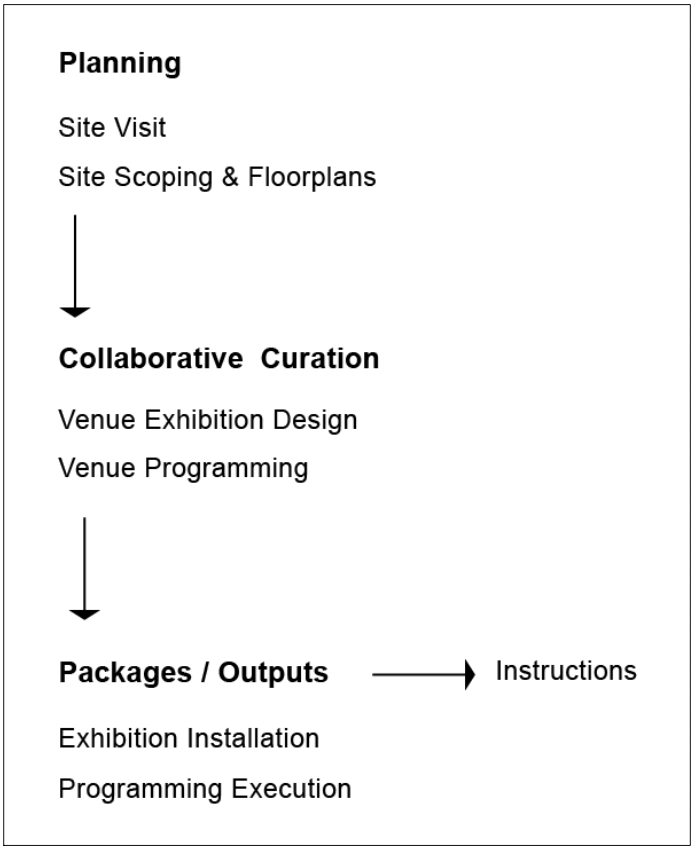

Figure 7. Workflow of the groupware

4 Conclusion

An interdisciplinary research team is working with community participants in diverse geographical locations. The team desires to engage in real-time, participatory, and reflective collaboration with geographically remote participants to collaboratively curate each site for an upcoming touring exhibition of the community-built archive. To do so, designers and design researchers on the project have employed user-centred design methods to plan, design, and develop a collaborative curation groupware tool. The application of user-centred design for an otherwise participatory design centred research project demonstrates how multiple design and design research mindsets—with their own sets of methodologies—can come together to contribute in multiple ways for large interdisciplinary, community-engaged research.

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Ethical Principles for Design

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The paper explores ethical aspects of design from the perspective of normative ethics. It develops a set of normative principles for design against the theoretical backdrop of moral philosophy and the specific characteristics of design as a creative and function-oriented field. The paper provides a systematic ethical approach and critically reflects on the ethical underpinnings of prominent design approaches, such as user-centred design, green and sustainability design, and design addressing societal issues. It specifically focuses on the role of design with regard to ethical challenges of the 21st century, such as sustainability and globalization, and proposes a reconstruction of professional responsibilities for functionality and creativity in this context. The paper particularly promotes normative principles for design that foster creative potential in humans and nature, sustainable development, and positive societal and intercultural relationships.

Keywords: Design ethics; normative perspectives; principles; sustainability; creativity

1 Introduction

This paper explores potential ethical principles for design from the perspective of normative ethics. Normative ethics is a philosophical field that aims to justify norms and values by rational argumentation. At the core of the paper is the question of what ethically good design is. This is a crucial question that has been addressed and answered in various theoretical reflections and design manifestos. Influential normative conceptions include user-centered design (Norman & Draper 1986; Norman 1988), green and sustainability design (Graedel & Allenby 2010; McDonough & Braungart 2002), design promoting societal values and individual rights (see e.g., Talen & Lee 2018; Keates & Clarkson 2004) and design respecting cultural values. The paper reflects on a range of normative guidelines for design and their justifications. It aims to determine a set of normative principles for design that specifically meet major challenges of the 21st century, such as sustainability and globalization. The paper develops its conception of design ethics against the theoretical backdrop of moral philosophy, and considers specific ethical implications that follow from the definition of design as a creative and function-oriented field.

Applied ethics generally needs to consider ethical criteria as they relate to the specific characteristics of the field of action in question, in this case, design. What matters ethically for designers may differ to some extent from general ethical requirements that hold for everyone, and may also differ from ethical aspects of other professional fields, such as health care or education. Thus, a careful determination of the specific characteristic and

ethical aspects of design is a crucial prerequisite for any systematic conception of design ethics.

The paper develops an ethics of design against the backdrop of three basic characteristics of design. First, the paper defines and understands design as *creativity operating on function*, that is, as creative expression of a specific function into a concrete form. With this, design is a combination of creativity and functional rationality and, in many cases, a synthesis of art and technology. This definition of design includes a broad range of fields, such as fashion, architecture, software, IT, various fields of engineering, and crafts. By this definition, design is distinguished from art. Art is a free expression of creativity that is not bound to any specific functionality or use. Design is creativity operating on, or dealing with, functionality. As soon as design completely ignores or annihilates functionality, it is no longer design, but potentially art. For instance, fashion design is highly creative, but even the most ingenious fashion design still fulfils the function of being worn on the body. If some design cannot possibly be worn, it is not fashion anymore, but it might be considered artwork. Likewise, one can design chairs in endless ways and forms. Yet to count as design of a chair, the design must uphold the function of a chair by enabling people to sit on it. If the design disallows sitting, the function is lost, and the design is potentially artwork representing, or reflecting on, the concept of a chair.

Second, the paper assumes that design typically serves and supports a certain practical purpose. Fashion serves the practical purpose of covering the body, chairs serve the purpose of sitting down, software is designed for specific purposes, and so on. In this perspective, design is, in the broadest sense, part of the realm of modern technology. Technical objects are instruments for practical purposes, they are means to pursue given tasks. Technology usually increases efficiency and comfort, and more broadly, is meant to improve human conditions on earth (Bacon 1863; Becker 2012). Technology is useful and has an instrumental value for people. With this, design is not only part of technology but at the same time part of modern business and the economy. Design provides, or contributes to, goods that are practically useful and valuable to people and, in virtue of this, is part of the overall economic realm of production, distribution, consumption, and disposal.

Third, the paper considers that design, because it is realized in objects that enter into individual lives and societal and environmental contexts, has intended and unintended effects to individuals, societies, the global community, the environment, and future generations. This involves crucial aggregate effects and resulting issues, such as the tendency of current technological and economic systems to overburden the carrying capacity of the earth and negatively impact the well-being of future generations and people around the world (MEA 2005; UNEP 2012; Becker 2012). The paper argues that modern design operates in the realm of technological and economic systems and, because of this, has a specific function with regard to new ethical challenges and specific responsibilities. Design needs to consider its role within modern technological and economic systems and their impacts on future people, people around the world, and nature.

Against the backdrop of the specific characteristics of design outlined above, design ethics needs to consider and combine three fundamental elements: first, ethical principles for design that follow from general moral philosophy; second, ethical implications that follow from the specific characteristics of design as a creative, function-based and use-oriented

field; third, the responsibilities of design in meeting crucial ethical challenges of sustainability and global relationships.

The remainder of the paper is organized as follows. Section 2 outlines basic ethical principles for design that follow from moral philosophy and discusses implications from those principles for the field of design. Section 3 determines specific ethical principles for design that follow from the characteristics of design as creative, function-based field. Section 4 defines principles for design that address main challenges of the 21st century, namely, sustainability and the promotion of positive global and intercultural relations. Section 5 provides a short conclusion.

2 Basic ethical principles for design

Moral philosophy has been studying conceptions of the right and the good for over 2000 years. Although there is no definite definition of the right and the good, moral philosophy has developed some pretty good approaches and criteria for addressing ethical issues. This section refers to three main approaches of moral philosophy to develop basic principles for design: utilitarianism, Kantian ethics, and virtue ethics. These three approaches represent typical ways of ethical reflection and argumentation: argument by consequence, by principle, and by character (Becker 2019). They also represent the main theories used in normative (applied) ethics today. I will outline each theory and its implications for design in the following.

2.1 Utilitarian principle

Utilitarianism is an ethical theory that refers to the consequences of actions. It considers each person affected by an action, and the way in which everyone is affected. Utilitarianism considers whether an action increases or decreases happiness. Happiness is measured in terms of pain and pleasure (harm and benefit) that the action inflicts to each person affected. What matters for the ethical evaluation of an action is the overall outcome in terms of happiness: How much overall happiness does an action produce if one considers and summarizes harms and benefits to all affected by it? Comparing a given set of alternative actions, utilitarianism considers the action that maximizes overall happiness of all affected as the ethically best action. In other words, an action is ethically better than its alternatives if it produces more overall happiness that its alternatives (Bentham 1988; Mill 1998). Based on utilitarianism, one can formulate the following basic ethical principle for design:

Utilitarian principle: Design should promote the overall happiness of all affected by it

2.2 Kantian principle

Kantian ethics, the ethical approach developed by the German philosopher Immanuel Kant (1724-1804), provides an ethical argument by principle. In contrast to utilitarianism, Kant argues that the ethically right action is defined by the right motivation rather than by its consequences (Kant 1998: 8). The right motivation is established by reason, which identifies fundamental ethical principles. At the core of Kantian ethics is the *Categorical Imperative* which states that one should only act according to principles which one could reasonably want everyone in the world to adopt and follow (Kant 1998: 31). In the context of this paper, I refer to another formulation of the Categorical Imperative that emphasizes the unconditional value of every human being as ends in themselves: “So act that you [treat] humanity, whether in your own person or in the person of any other, always at the same time as an end, never merely as a means” (ibid.: 38). In other words, no one should be treated as a mere object, but everyone should be respected as being endowed with reason and an end in

herself. This implies, for instance, that any design is unethical that is complicit with, or results in, any form of manipulation, abuse of power, exploitation, human rights violations, or disrespect of individuals and cultures. One can summarize and condense the Kantian perspective by formulating the following second basic ethical principle for design:

Kantian principle: Design should promote respect for the dignity of every human being

2.3 Virtue principle

Virtue ethics is not very interested in the single right action but instead aims at defining and promoting conceptions of a good character and a good life, of human excellence and human flourishing (Aristotle 2000; Crisp & Slote 1997). At the centre of virtue ethics is the concept of virtue. Virtues are excellent character traits that define who somebody is and how somebody acts and interacts with others. Virtues enable persons to interact with others in exemplary ways and promote positive relationships and communities. Virtue ethics typically perceives virtues as ideal, excellent character traits that people aim to develop through practice and experience over time. There is no definite list of virtues but typical examples are honesty, integrity, responsibility, attentiveness, and care. Virtues are potentials that every person can develop. Virtue ethics promotes the idea that everyone should strive to develop one's own potentials toward excellence and become the persons she wants to be. In this sense, virtue ethics promotes human flourishing. Based on virtue ethics, one can formulate a third basic ethical principle for design:

Virtue principle: Design should promote human excellence and flourishing

2.4 Implications for design

The remainder of this section discusses some implications from the basic ethical principles for the field of design. From the perspective of all three ethical theories outlined above, design needs to ethically consider its impacts on people and the world. Designed objects enter the lives and interactions of people and have various effects on others. Depending on the ethical perspective, there are different ways to consider such impacts. Also, one needs to decide whom to consider with regard to the impacts and implications of design.

Obviously, design directly impacts the persons who use the designed objects. The direct impact of design to its users has been the focus of the conception of *user-centered design* (Norman & Draper 1986; Norman 1988). User-centered design promotes the idea that design should care about the perspective, wellbeing, and interests of the users of designed objects. The approach is not typically derived from moral philosophy but is implicitly based on ethical assumptions about why, and in what ways, designers should consider the perspectives of users. Referring to the above ethical principles, one can formulate potential ethical underpinnings for the conception of user-centered design.

The utilitarian perspective would consider the pleasure or pain a design inflicts on its users. A design should enable a user to perform some given function. If a design was counterintuitive, flimsy, inefficient, unpleasant, or unsafe, it could cause emotional, physical, or financial pain to the user. Obviously, any alternative design that is more intuitive, solid, efficient, aesthetically appealing, or safe and, as a result, less painful and more pleasurable to the user, would be considered ethically better in a utilitarian perspective, given all other effects are equal. From a Kantian perspective, one would perceive any design that ignores the rights of users, or considers users as mere means or objects, as disrespectful and unethical. Design should be user-centered in the sense that the designer always considers

the users as ends in themselves and as beings endowed with reason, and never as mere means to achieve some further ends, for instance, technological or economic ends.

The user-centered approach is insightful but results in an overall limited ethical perspective. It leaves out many ethical questions about the role of design for societies, the world, nature, and future generations. A designer does not only have moral obligations to the users of her design. Design plays a crucial role within an entire society and its complex interrelations, and the designer also has responsibilities for the overall societal impacts of her design. A societal perspective would develop a more differentiated perspective on the societal role of design. It would consider (i) the various stakeholders to which the design matters, (ii) societal challenges, issues, power structures, and group dynamics, and (iii) specific ethically relevant topics, such as social justice, diversity and inclusion, racism, gender and age discrimination. A design that is attentive to, and considers, all three aspects can be called *socially responsible* design.

The relevance of a broader societal perspective on the ethical responsibilities of design can be easily seen with some examples. The design of a car should certainly be user-centered. It should consider the right of the user to her own safety and respect users' preferences for reliability, efficiency, intuitive use, and comfort. However, cars also have ethically relevant impacts on others. For instance, not only does the user of the car have a right to safety, but so do all other road users. Socially responsible design would aim to contribute to the overall safety of cars for the user and other road users, for instance, pedestrians. There are design solutions that design the bumper and front part of cars in ways that reduce risks of injuries for pedestrians in case of an accident. Recently, new design solutions help to automatically detect and prevent collisions, which benefits both the driver and other road users. Future design of self-driving cars has the potential to further consider the safety of all road users in a significant way. Socially responsible design would consider the impacts of a design to all stakeholders and aim to create a win-win for all.

Socially responsible design would also consider general societal issues and fundamental values and rights. Design has a specific role and specific responsibilities with regard to societal issues. Design that is unaware of societal issues might unconsciously contribute to them. For instance, gender patterns could find their way into design and be reinforced by it. Examples for gender bias in design are, for instance, car safety features based on average size and weight of men, design of consumer goods and drugs based on average male bodies (Criado-Perez 2019), and information and communication technology based on male preferences (Oudshoorn et al. 2004). Such design is discriminatory, perpetuates gender roles and power structures, and is potentially harmful to women. Similarly, design can unconsciously contribute to age discrimination, for instance, when the design of an object makes it hard to use for elderly people. Design can also discriminate against people with disabilities, for instance, when a building design is not accessible. Socially responsible design should be attentive to such biases and avoid design that contributes to discrimination. Ideally, socially responsible design actively addresses issues such as social justice, discrimination, and racism, and actively supports fundamental values and norms, such as human rights, freedom, equality, diversity and inclusion, and respect. Design has its own means and powers to promote such values. As designed objects enter society and are often used by a large variety of persons and in various contexts, they can unfold powerful messages. In some instances, design may even be able to assume ethical leadership and provoke rather than please the users and established stakeholders. Provocation can be a

justified means to uncover injustice and ethical flaws in society and design, and to promote ethical values.

The impacts discussed so far are more based on traditional ethical perspectives that focus on ethical aspects within well-defined societal contexts. However, design also impacts people around the world, nature, and future generations. Such impacts have become more relevant in recent years as concerns about sustainability have become more pressing in the 21st century. We will discuss further this topic and resulting implications for design ethics in Section 4.

3 Specific ethical principles for design

Section 2 defined and interpreted ethical principles for design that have been deduced from moral philosophy. This section deduces specific ethical principles for design that follow from the characteristics of design as a distinguished field of practice. Although there is some overlap with the basic ethical principles and their implications, the perspective in this section is more directly concerned with specific professional responsibilities of the designer.

3.1 Functionality

As outlined in the introduction, design can be defined as creativity operating on function and contributing to the realms of technological means and economic usefulness. By this definition, designers have a professional responsibility for functionality. Considerations of further criteria, such as aesthetics and cost efficiency, should not result in compromising, undermining, ignoring, or even destroying functionality. As a professional, the designer needs to consider and support functionality. If he only cares about aesthetic aspects, he might be a better artist than designer, if he only cares about efficiency, he might be a better economist than designer.

Principle of responsibility for functionality: design should consider and support functionality

The professional responsibility of the designer for functionality can be interpreted in different ways. One can interpret it as the responsibility to actively support functionality in the best way possible. In this perspective, the designer would not compromise functionality by aesthetic or other criteria. Functionality would be the leading criterion for design. This is in line with the well-known design paradigm ‘form follows function’. However, the designer is often faced with conflicts between functionality, aesthetics, and efficiency and may need to balance various requirements for the design. Even if functionality would be considered the leading criterion, the designer might still want to strive for ways to create a win-win by finding a design solution that simultaneously optimizes aesthetics, functionality, and efficiency.

One can also interpret the designer’s professional responsibility for functionality in a more limited way: as the responsibility to not compromise functionality by other criteria for design in ways that make the design potentially harmful for users or others. In this perspective, the responsibility for functionality is limited: the designer just has to make sure that the design is safe to use. This correlates with general ethical principles outlined in Section 3. However, it is worth to define safety separately as professional responsibility of the designer, because this principle follows from the core function of design to consider and uphold functionality:

Principle of safety and care: design should prevent harm by the designed object

3.2 Creativity

The third professional responsibility that follows from the definition of design as creativity operating on function, is responsibility for creativity:

Principle of creativity: Design should promote creativity

This principle requires some explanation and interpretation, as it may not be obvious what responsibility for creativity means and why creativity involves ethical aspects of design. Creativity is at the core of the definition of design, as is functionality. One can argue that creativity is not subordinate to functionality, a mere servant to function, but has equal status and value within the context of design. Even approaches that prioritize functionality may still recognize creativity as an essential element of design that has its own status and value in design.

Creativity can be considered as having ethical quality, in so far as it is crucial for human flourishing and excellence. Creativity, understood as power to bring forth new ideas and things, is part of the human condition. Humans are creative beings, as they are rational beings and beings capable of ethical judgments. Humans create artwork, music, invent new technologies, and so on. Creativity is part of the potential human beings have and part of human flourishing and a good society. Creativity, aesthetics, and beauty, enhance human lives and societies, provide inspiration and meaning, represent unique ways of reflection on human existence, society, and the world, and have the potential to connect people and cultures and make the world a better place. Against this backdrop, one can argue that designers, similar to artists, have a professional obligation to promote creativity and its positive potentials for individual lives, communities, societies, and cultural relationships, because creativity is a defining core function of their professional work.

Creativity today is even of further ethical relevance and has a new quality of importance in design ethics. We will further elaborate the relevance of the principle of creativity with regard to the challenges of the 21st century at the end of the following Section 4.

4 Ethical principles for design in the 21st century

Design needs to consider the (ethical) challenges the world is facing in the 21st century and implications of these challenges for modern design. This section discusses ethical principles for design in the 21st century with regard to two major challenges: globalization and sustainability.

4.1 4.1 Globalization

The world today is more globally interconnected than ever before in history. The economic system is essentially a global system with complex, heavily interconnected production, distribution, consumption, and disposal mechanisms. Internet, media, and social media are global systems that enable large and fast-flowing communication and information around the world. Modern design is challenged by globalization in various ways. Design has impacts around the world, as designed objects are often produced, distributed, used, and disposed globally. Design should carefully reflect on, and consider, its impacts and resulting ethical implications. Furthermore, operating within the context of various cultures can be a source of inspiration and positive interrelationships, but it also poses challenges of adequately respecting cultural values and differences. Within the modern global context, design should develop a global perspective, recognize its responsibilities for the effects of design in a

global world, and strive to assume a positive role in enhancing global, intercultural relationships:

Principle of enhancement: Design should strive for a positive impact to the world

Design should specifically promote respect for cultures. This includes the awareness of potentially offensive design and cultural appropriation. Design should use its powers to promote positive intercultural and global relationships. Design, similar to other creative endeavours, such as art and music, has the potential to easily overcome language and cultural barriers and connect people. Design can foster participatory relationships and inclusive design practices, and promote human rights and fundamental values on the global scale.

4.2 Sustainability

In addition to developing cultural and global awareness, modern design also needs to consider environmental and future impacts. The sustainability perspective integrates a global perspective with an environmental and long-term perspective (Becker 2012). Design operates in the realm of modern technology and the economy, which both have significant side-effects not only to people around the world but also to the environment and future generations. From an ethical point of view, and referring to the ethical approaches introduced in Section 2, one can argue that all people around the world and all future people have the same right to not be harmed, to be respected in their dignity, and to have equal opportunities for flourishing and developing their potentials. Furthermore, one can also argue that non-human beings have rights to not be harmed but to flourish, and that life and nature are values in themselves which need to be respected and cared for. The approach of sustainability ethics promotes such an overall integrated ethical view on the rights of contemporaries, future generations and nature, as well as the resulting responsibilities of today's actors (Becker 2012). Design should carefully consider its own role and responsibilities within the sustainability context and use its own means to avoid global, environmental, and future harm, and contribute to a sustainable future:

Principle of sustainability: design should promote sustainability

Design can play an important role for sustainability. In some areas, design may even be a key function for sustainability. In many cases, design significantly determines the overall environmental and global impacts of the product. For instance, fashion design can consider the fibres used in the design and what fibres have the best ecological footprint and avoid harm to people around the world. It is well known, for instance, that the sourcing of cotton is rather harmful to the environment and people (WWF 1999), and fashion design might consider using alternative fibres in order to promote sustainability. In industrial design and engineering, the potential of design to influence sustainability is also significant. For instance, the design of a smartphone largely determines its ethical and ecological footprint. Earlier designs included lead, mercury, and other toxic materials which are environmentally damaging when the phones are disposed (Grossman 2006). Newer designs usually avoid using these substances. Design can also influence to what extent, and at what costs, a product such as a smartphone can be recycled (Graedel & Allenby 2010). If design already considers efficient automated deconstruction of a product and the possibility to retain valuable materials from it, recycling becomes technologically and economically viable. If design enables recycling, this also has significant effects on the sourcing of raw materials.

Materials that can be regained through recycling do not need to be bought as raw materials, and as a result, do not need to be extracted. In a world of limited resources, this would be beneficial to future generations (Graedel & Allenby 2010; Mc Donough & Braungart 2002). Also, many extraction processes are environmentally damaging. In some cases, for instance, with regard to conflict minerals, extraction also involves human rights violations and other unethical practices (Enough 2009). Recently, the electronic and other industries are moving toward closed-loop processes that aim to regain materials from their old products for producing new ones. With this, closed-loop processes result in a double dividend: they reduce waste and extraction of new materials. Design has a key function in this development (Graedel & Allenby 2010).

If design specifically aims at improving the ecological footprint of products or processes, it can be called *green design*. Design that simultaneously considers its impact on the environment, future generations, and people around the world, can be called *sustainability design*. Sustainability design intentionally considers the implications of the designed object for (i) the environment, (ii) global and intercultural relations, and (iii) future generations by either minimizing its overall harm to all these entities, or by aiming at an overall positive contribution to them.

4.3 Promoting creativity in the 21st century

As outlined in Section 3, creativity is a core element of design, and designers have a professional responsibility to promote creativity. Creativity is valuable and should be promoted because it is essential to the human condition and human flourishing. However, one can further argue that creativity has value and importance even beyond the realm of humankind. Creativity can also be found in nature. Nature is in fact an original creative power that brings forth endless new forms of life and species through evolution. Nature can also be perceived as creative with regard to the many ways in which organisms have developed highly specific features to adopt to their environments. Against this backdrop, creativity fundamentally connects humans and nature and provides a common ground for both. Creativity can be considered as fundamental to human existence and existence in general (Heidegger 1977). Human creativity is not absolute but operates in the broader realm of creativity in the world (ibid.). Human creativity can be destructive or constructive. Creativity is constructive if it enhances human lives and relationships between people, promotes values, understands its role within nature's creativity, and is realized as a positive force in the world. Creativity can be a positive force if it is perceived as a co-creative power, working with nature and not against it, working with others and for other generations and not against them.

Design has specific abilities and responsibilities to promote creativity as a value and a positive force in the world, and to promote co-creation with nature. In contrast to art, design has the potential to reach more people, and its objects have a direct relevance for, and impact toward, nature, humans, and their interrelations.

Principle of creativity (extended version): Design should promote the potential of human and nature's creativity in the world

Design can promote creativity as a positive force and a means to relate humans and nature in various ways. Design can, for instance, refer to nature for inspiration and celebrate nature's creativity in designed objects. Design can be inspired by aesthetic aspects found in nature or by nature's functionality. The latter is sometimes called *biomimicry* (Benyus 1997).

Examples for biomimicry would be the design of swim suits that mimic the microstructure of shark skin. The surfaces of the suits are characterized by very small overlapping shingles which reduce friction compared to classical smooth surfaces and enable swimmers to swim significantly faster. Other examples of nature's 'design' inspiring human design are the stickiness of the feet of geckos, the strength and elasticity of spider silk, the bio-chemical reaction of photosynthesis in leaves, or closed-loop processes in ecosystems (ibid). Design that is inspired by such natural features is to some extent attentive to and promoting the creativity of nature. However, mimicking nature will not by itself protect nature and nature's creative potentials. For this, design must also be sustainability design and actually care about the preservation of ecosystems and biodiversity as the basis for nature's creative powers. The principle of creativity would only be fully realized if design comprehensively cares about the creative potentials of both humans and nature. Ideally design would perceive its own creativity as part of, and a contribution to, nature's creativity and aim to promote both.

5 Conclusion

Ethical principles for design encompass responsibilities for users, stakeholders, society, nature and future generations (Table 1). With regard to the challenges of the 21st century, modern design should specifically consider its responsibilities toward people around the world, future generations, and nature, and develop conceptions of sustainability design. This specifically implies reconsidering design's professional responsibilities for functionality and creativity within the broader context of sustainability and globalization.

In a world that is facing crucial challenges of sustainability and global relationships, design could have a positive impact and play an important role. The positive powers of creativity in human and nature are threatened in a world dominated by economic and technological perspectives and narratives. Humans are creative beings and their creative potentials, if properly understood, guided and used, can connect humans across cultures and times in a positive way, and reframe the human-nature relationship as a respectful relationship of co-creativity. Design has specific responsibilities and potentials for promoting the positive potentials of creativity. Design is prevalent and accessible for people around the world, as it is embedded into many technological and economic objects of everyday use. From within the very systems that threaten the environment and future and produce abstract tacit global relationships, design can reach people with positive messages of creativity and promote sustainability and fruitful global relations.

Table 1: Ethical principles for design

Utilitarian principle	Design should promote the overall happiness of all affected by it
Kantian principle	Design should promote respect for the dignity of each human being
Virtue principle	Design should promote human excellence and flourishing
Principle of functionality	Design should consider and support functionality
Principle of safety and care	Design should prevent harm by the designed object
Principle of enhancement	Design should strive for a positive impact to the world
Principle of sustainability	Design should promote sustainability
Principle of creativity	Design should promote human and nature's creativity

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Global Artisanship Models for the Craft Sector

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The burgeoning slow fashion world has grown alongside that of eco activism, resulting in a renewed interest in global artisanship. Yet models for sustainable development in the craft sector are varied, with a wide range of strengths, weaknesses and motivations. Through a qualitative multiple case study, grounded theory approach, this paper constitutes part of a greater research project that evaluates the successes, weaknesses and challenges of the various models of sustainable development, with the overall intent of building a database of best practices, and in an effort to propose business models supportive of the craft and artisan sector in the developing world.

The three main categories of sustainable development in the craft sector were identified as; 'Market Access', 'New Skills' and 'Artisanal Partnerships', each with different missions and models. This research seeks to establish the connections between the levels and types of intervention, the tier of market distribution, and the long-term support for the sustainment of traditional craftsmanship.

Keywords: craftsmanship; artisanship; sustainable development; heritage craft, luxury fashion; Sustainable Development; IASDR

1 Introduction

The relatively recent revaluation of DIY and local maker communities has grown in visibility and reach with eco-activism, and the exposure of the hidden price tag of fast fashion (Riddselius 2011, Clean Clothes Campaign 2012). The popularity of magazines like Selvedge, and Hand Eye, honoring the authenticity of making, has been bolstered by a multitude of blogs, websites, E-zines, and documentaries (Handmade Nation 2008, Sweatshop 2014). On shared, open source platforms, the world of slow fashion has used the digital environment to like, share and learn in a collaborative environment (Luckman 2012).

The massive growth of the luxury branded landscape is simultaneously reaching saturation, with the same product available from Mongolia to Milan (Kingsnorth 2009, Walker 2018) The over exposure of the 'bling-bling' culture of hip hop, anorexic models, excessive photo shopping in the media, a single, narrow ideal of beauty, youth and celebrity culture, are all at saturation point, causing a backlash from consumers and designers alike. The onslaught of garment factory disasters has drawn attention to the true cost of fast fashion (True Cost 2015, Fashion Revolution 2017), and nothing but distaste for over-consumption (Worldwatch 2013). As diverse as all these topics seem, they culminate in a revolution of our collective value systems. The result is a re-evaluation of authenticity, of value and what constitutes

luxury, guiding a renewed focus on ethical sourcing, sustainable materials and the re-evaluation of craft.

An appropriate strategy and method are needed for the preservation of traditional craft. (Nugraha 2018) The current models that support sustainable development in the craft sector are diverse, with a variety of focuses, strengths, weaknesses and intents. They include those that facilitate market access whether that is local or global, physical or digital (Cohen 1989), those that facilitate market access with business, logistical and other supports, as well as those that offer minimal design intervention, all the way through to complete imposition of aesthetic and process on tradition. There are models that teach a new skill, and those that partner with artisans, that are sensitive to their material culture, who work together to develop new products that appeal to a new market. The product outcomes of each of these models are sold through a range of tiers of distribution and price points.

2 Sustainable Development

2.1 The History

The original models for sustainable development in the craft sector was the exclusive domain of government agencies, NGO's and faith based organizations, with a mission to help the disadvantaged in the developing world, and craft merely a means to an end. As a result of that, neither the craft nor the final product was considered as important as the social mission to raise standards of living, and to lift people out of poverty. Undertaken predominately from a charitable perspective, this approach often meant that the longevity of market development was never fully realized (Holroyd 2018). In great part, it resulted in a product without major market traction. In some instances selling was never even considered as part of the model, while with others it was simply not the main focus (Johnson 2018). The consequences of this model, has often resulted in an undervalued global craft item, or the "trinketization" of crafts (Urry and Larson 2011). In many cases, the result is a watered-down version of a traditional artifact, made with inferior materials, and less skill, an item with only monetary relevance to those producing it, and only geographic relevance to those purchasing it (Howes 1996, Nugraha 2018). A phenomena called the Carved Giraffe Theory by Stacey Edgar (2011), and 'Field of Dreams thinking' (Ingram 2017), where NGO's fund products without an end market in mind.

Over time this model has given rise to a range of for-profit, mission-driven businesses that expanded on the mission of the developmental aid agencies by facilitating greater market access for artisans. The original mission driven businesses merely facilitated market access without any intervention in the production of the final product, much as their progenitors, the aid agencies did before them. With a business focus as the means to facilitating change, many of these mission-driven for-profits' do intervene in quality control and material standards, as well as logistics and curated content, in an effort to gain greater market acceptance. Both of these types of for-profit mission-driven businesses however, do not intervene in the designing of the product in any significant way, and focus on the mainstream market as the one that affords greater profits, and thereby results in greater impact on artisans' lives.

2.2 Need for Sustainable Development

Women overwhelmingly constitute the majority of the world's artisans and craftspeople, with 65% of artisan activity taking place in the developing world, and constituting a $34 billion

market (Artisan Alliance, 2014). Women do 66% of the world's work but earn only 10 percent of the income, and own only 1% of the property (UN Women 2014). The impact is especially great for disenfranchised women artisans from developing countries, where artisanal work is second only to agriculture in terms of employment (UN Sustainable Fashion Alliance 2015).

The aim of this paper is to evaluate one model of sustainable development that promotes and markets craftsmanship and artisanship from the developing world to the Western market with minimal intervention: the market access model. The greater aim of my research, of which this paper represents the formative stage, is to evaluate the range and types of sustainable development models in the craft sector. To propose a theoretical, customizable framework that effectively serves to sustain traditional craftspeople and their material culture. And to evaluate and compare what is meant by success, whether that is the number of artisans reached, or the retention of traditional craft, and the balance between the two.

2.3 Participant Recruitment

A broad range of mission-driven for profits, not-for-profits, NGO's, governmental agencies and faith-based missions were evaluated. The case studies were chosen to represent a variety of craft skills, and end products as it pertains to apparel and accessories, and to cover a range of businesses from small to large in scale. A broad global spread was sought in the selection of the case studies, intended to explore the connection between the type of intervention, the market placement, and its relationship to success.

A long list of potential brands and institutions were compiled from a variety of resources (Artisan Alliance; Ethical Fashion Initiative; Common Objective; the Artisan Resource; the International Folk Art Market exhibitor list; and Aid to Artisans). Entities were prioritized to represent a breadth of material expressions, craft techniques, and levels of intervention that ranged from minimal to maximum, type of organization, geographic location, market served and price range. The list was then subdivided into the main identified themes of; Market Access; Skill Imposition; and Design Partnerships, referred to by Nugraha (2018) as 'preservation', 'revitalization', and 'transformation'. There were very few pure cases that fell neatly into one category, resulting in a sliding scale of the various types of intervention, rather than a simple categorization, something referred to by Murphy (2018) as 'interconnections, interdependencies and messiness'.

3 Methodology

This cluster of case studies evaluates the strengths and weaknesses of a range of enterprises that provide market access to artisans, focusing on those that exert little or no design intervention. The six case studies are: Global Girlfriend, Ten Thousand Villages, the Santa Fe International Folk Art Market, Threads of Life, Centro de Textiles Tradicionales del Cusco and KUR Collection.

This study is qualitative in nature, and based in Grounded Theory, reflecting the constant comparative nature of the multi-case study methodology (Cassidy 2018), with the intended result being a study that is useful in practice (Glaser and Strauss 2000). The types of data collected included in-depth interviews, observations, product evaluations, the entities own website, blog, annual or impact report where produced, as well as articles in the public domain.

The case studies began with common interview questions focused on market positioning, curation of product, range of crafts represented, and levels of intervention, as well as respect

for the tradition of craft practiced. The organization and analysis of data helped identify areas of missing information, prompting follow up questions, additional research and directing the selection of further case studies. The analysis of data was divided into three phases. Data Reduction, which helped to keep the project manageable by limiting the amount of data, and which was supported with the use of coding software NVIvo. The coding process required the attaching of concepts to data, and the building of relationships between concept codes (Urguhart 2013). The second stage of Data Display helped with the organization and display of data with the use of charts, and matrices (Robson 2014). The final stage of conclusion drawing and verification began at 'the start of data collection, with material analysed for a general sense of data content, important themes, impressions, emergent patterns and areas of contradiction (Miles and Huberman 1994) and to generate theories. The overarching categories identified were: Artisanship, Developmental Aid, Intervention, Motivation, Philanthropy, Problems, Product, and Reporting, with most harbouring sub-nodes and relationships between concepts, creating clusters around categories.

4 Data collection and Analysis

The criteria for evaluation of collected data are the effectiveness of artisanal empowerment, the respect for the culture and heritage of the craftspeople, and the ability to sustain or regain the craft traditions in the long-term. The perceived value of the end products was assessed through the tier of market penetration (mass through luxury).

4.1 Data Display

The charts developed were: Levels of Intervention, Empowerment Measures, and Range of Artisanship. Organizational charts were recorded, and a brand matrix was developed to record market placement. The development of these charts helped to present my research and identify emergent themes as I continue to develop frameworks to evaluate concepts that lead to insights and understanding.

The Levels of Intervention chart is intended to record and compare the various types of intervention on the artisans from a variety of perspectives. Design intervention is defined as the level of imposition made on an artisan to produce something that is not part of their aesthetic tradition, with ‘no intervention’ implying the final product is entirely the product of tradition, and ’total design intervention’ the complete imposition of an external design. Product Development is listed separately from Design Intervention to separate the developmental processes used. Quality Control is understood as a system of maintaining standards of production from a technical perspective. The criteria of Business Intervention is intended to record the level of support given to the artisans on business development, and the Design Curation criteria is intended to record the level of influence exerted through the selection of products purchased.

Table 1 Levels of Intervention Comparison Chart.

Measure	None	Minimal	Significant
Design Curation	TOL CTTC	KUR	IFAA GG 10,000
Design Intervention	IFAA TOL KUR	GG CTTC	10,000
Product Development	IFAA TOL CTTC KUR	GG	10,000
Quality Control		TOL	IFAA GG 10,000 KUR
Business Intervention	CTTC KUR	IFAA 10,000	TOL GG

Legend:
10,000 = Ten Thousand Villages
CTTC = Centro de Textiles Tradicionales del Cusco
GG = Global Girlfriend
IFAA = Santa Fe International Folk Art Market
KUR = KUR Collection
TOL = Threads of Life

Artisanal Empowerment is defined as the level of autonomy granted to the artisans. Respect for Culture is intended to evaluate the level of appreciation for traditional material cultural.

Table 2 Levels of Intervention Comparison Chart.

Measure	None	Minimal	Significant	Extensive	Total
IFAA Artisanal Empowerment				Extensive	
IFAA Respect for Culture				Extensive	
GG Artisanal Empowerment			Significant		
GG Respect for Culture		Minimal			
TOL Artisanal Empowerment					Total

TOL Respect for Culture					Total
CTTC Artisanal Empowerment				Extensive	
CTTC Respect for Culture				Extensive	
TOL Artisanal Empowerment			Significant		
TOL Respect for Culture		Minimal			
KUR Artisanal Empowerment			Significant		
KUR Respect for Culture				Extensive	

5 Results

Cross comparison between the levels of Intervention and the brand matrix, revealed that the enterprises that exert the least Intervention are those that produce more traditional products.

A comparison between the levels of Empowerment and levels of Intervention reveal a defined correlation between the highest levels of Empowerment and the lowest levels of Intervention. Similarly a comparison between the Brand Matrix and the Levels of Intervention reveals high levels of intervention corresponding with lower Market Value.

A comparison between the Empowerment Chart and the Brand Matrix reveals that those that empower the artisans the most, predominately sell in the ‘Premium to Luxury’ marketplace, producing a ‘Traditional’ product, while those that produce contemporary products, tend to sell in the value or mass market, and rank significantly lower in empowerment measures.

There is a long reverence for traditional indigenous art, and world craft, but predominately through the lens of historic artefacts, ethnography and curation. Contemporary efforts to revalue traditional craft is often viewed through well-meaning trade-not-aid undertakings, training disadvantaged communities a new skill. Many designer collaborations overstate the developmental component of their undertakings, while underplaying the material culture by introducing new skills, instead of working with traditional ones. This has resulted in the dumbing down of tradition (Edgar 2011, Harrod 1999).

There are a large number of the well-meaning NGO’s that work with heritage craft skills, but whose complete lack of intervention in the final design, results in an undervalued product that cannot gain traction in the sophisticated luxury market, ultimately, the market best placed to appreciate artisanship (Johnson 2018). Preliminary analysis has resulted in a broad alignment of type of intervention and market value. Those with minimal intervention in the end product are most often sold in local markets to aid workers and tourists, at a moderate price point. Those that impose a Western technique or aesthetic are mostly sold in the contemporary market at a mid-range price point. Those that collaborate with artisans in

long-term design partnerships that respect tradition while infusing Western design sensibilities are mostly sold in the premium market.

6 Conclusion

The need for companies to embrace sustainable development practices, combined with the loss of traditional hand-crafted techniques around the world (Walker 2018), potentially positions global artisanship as the future of luxury. Culture, history and heritage, are priceless, something the luxury fashion industry was based on, but lost sight of, as it shifted from family owned to corporate conglomerate (Edgar 2011). The authenticity of products made with heritage craft skill are a means of reinvigorating the over-exposed branded luxury fashion market (Murphy 2018).

Global craft needs more than a global audience for its long-term retention, it needs re-contextualization through collaborative partnerships (Holroyd 2018). It needs the tradition, the craft and the authenticity, reinterpreted through a collaborative process with a sophisticated aesthetic. It also needs the support of external agencies; a respect for traditional culture, the recognition of institutions such as museums as a component of national culture heritage, political and legislative support, not to mention the need for logistics in transportation and communication, often not a given in a remote artisanal population. Part of my ongoing research will be to evaluate the need for these supports, and to align them with the success of the entities studied, as well as review and evaluate the embedded values in the use of terms such as progress, and development.

The intent of my research is to consider whether global artisanship can be completely re-contextualized and valued through an equal partnership of traditional skills and sophisticated design. The partnering of design and craft can honor and value the tradition, the history of the craft, the context and the people, while simultaneously re-contextualizing it, through partnerships with sensitive and accomplished designers, to re-value the artisanal work with cutting edge, sophisticated designs (Walker 2018).

Few have yet to achieve the careful balance of contemporary design, artisanship and tradition that values each in equal measure, though some have come close. The success of brands such as Maiyet and Donna Karan's Urban Zen, who honor the heritage of indigenous craftsmanship, are helping to establish global artisanship in the luxury tier of the fashion industry, as well as the means to retain traditional material culture.

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Mapping Activity Theory To A Design Thinking Model (ATDT): A Framework To Propagate A Culture of Creative Trust.

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Throughout the world, incidents of hate crime are exponentially increasing and as a result, international media is permeated with accounts of social division and disconnect. It would therefore, be astute to advocate for the need to develop new, positive social connections and thus provide alternatives to this sustained and documented discord. Accordingly, this paper introduces, *Tridea*, an ongoing, multifaceted, project which facilitates collaborative practice and provides a conduit for design-with-purpose. Tridea invites participants to engage in an international, collaborative form of the Surrealist parlour game, the Exquisite Corpse, however, participation will be undertaken via an online platform; leveraging A.I. to assign virtual teams based on geographic and cultural diversity. It is therefore necessary to consider the inherent needs of participants in order to optimise user experience and facilitate effective engagement. Hence, Tridea implements a Design Thinking model as the fundamental framework for analysis, nevertheless, it also aims to extend beyond the immediate context of practice utilising theory grounded in Social Psychology to underpin Design Thinking strategy. In an attempt to analyse the creative process behind Tridea and provide an analytical tool to ascertain the strategies undertaken, Activity Theory (AT) has been mapped to a Design Thinking (DT) model (ATDT). This paper discusses how the ADTD model has been implemented thus far and reviews how utilising this bifold framework has impacted the creative process at its current stage; also considering how the ATDT framework will be applied as the project progresses and discussing potential applications of the framework for further research.

Keywords: Collaboration; Exquisite-Corpse; Design-with-purpose; Design thinking, Activity theory

1 Introduction

Today's media is permeated with accounts of social division and disconnect. Flatley, (2018) reports that in 2017/8 the number of hate crimes, in the UK alone, has more than doubled; an increase of 123% since 2012/13. With the world's media increasingly highlighting these divisions, this project's overarching aim is to promote inclusion, collaboration and altruism as a counter to this sustained and documented discord; ergo serving as a catalyst for change. According to Lorde (2007) "We have all been programmed to respond to the human differences between us with fear and loathing and to handle that difference in one of three

ways: ignore it, and if that is not possible, copy it if we think it is dominant, or destroy it if we think it is subordinate." (p. 115) This project champions an alternative to Lorde's suggested reactions to human differences – that is, to embrace them. Utilising design as a means of bringing culturally divergent communities together to create design-with-purpose, thus fostering a culture of mutual trust.

1.1 Concept, Context & Objectives

Tridea is an ongoing, multi-faceted creative research project which, facilitates international collaborative practice and intends to provide a conduit for design-with-purpose. The initial active phase of this project commences by approaching both amateur and professional designers, from around the world, to participate in an international, collaborative creative project: A digital form of the Surrealist parlour game, the *Exquisite Corpse*. The Exquisite Corpse is a method of collaging numerous drawings by several participants into one collaborative composition. The first participant creates an image, then folds the paper to hide the majority of their creation, leaving only the end visible for the next participant to continue with their contribution and so-on, until all three participants have contributed. However, due to geographical dispersion, the initial active phase of this project will be undertaken via an online platform; leveraging A.I. to assign virtual teams based on geographic and cultural diversity. The intention being, that participants originating from different countries and cultures collaborate to produce one multicultural, creative artefact; each trusting that the other participants will build-upon and enhance the overall composition. This A.I. technology will consist of filtering algorithms and will be custom designed in collaboration with an experienced web developer.

The second active phase repositions the project from digital to analogue with a series of hands-on workshops to be held in Singapore (and potentially internationally) and also encourages multicultural participation. This process follows more closely to the original Surrealist methodology of generating the Exquisite Corpse and provides opportunity for a novel comparative study of digital and analogue creations. The outcomes generated, from both phases, will be curated to form a collection of saleable art-prints and greetings cards. It is this project's intention that all profits from sales be donated to charities who aid in social inclusion through creative practice.

The notion of trust is the essential factor that compounds this complex project and by developing a platform to traverse trust across spatial, cultural and temporal boundaries the Tridea project aims to coalesce creative communities from around the world, build bridges and provide a conduit for international collaboration that encourages a philanthropic approach to design-with-purpose.

2 Methodology

This project employs design thinking, practice-as-research, as the fundamental framework for analysis. However, it also aims to extend beyond the immediate context of practice and utilise theory grounded in social psychology to underpin design thinking strategy. Given that this is a multi-faceted and complex project utilising both positivistic and phenomenological methodologies is intended to facilitate the establishment of a rigorous and holistic framework thus, affording adequate support for its complexity. Approaching this project from a combined pragmatic, constructivist ontological and epistemological perspective has also provided a consolidated but heterogenous theoretical blueprint for both design and analytical purposes.

This project adopts an interpretive approach and exploratory strategy. The exploratory nature of this project is required due to the sparsity of research conducted on trust building through collaborative practice, specifically in (Fischer, 2004) “computer supported co-operative work - CSCW” (p. 155) and simultaneously the lack of information pertaining to philanthropy as creative practice. This research focusses on building creative communities with altruistic intent and facilitating international collaboration, as such, an exploratory approach is appropriate due to the significant variables to be explored around these complex phenomena.

Activity Theory is the meta-theory chosen as an analytical tool to aid in both the design and evaluative aspects of this project. The following section now aims to explain the rationale for adopting Activity theory as an analytical tool and reviews the strategy of mapping this theory to an established design thinking model.

2.1 Research Method: Mapping Activity Theory to an Established Design Thinking Model

At the onset of this research it was intended that design thinking be the predominant method of praxis. However, this paper identified several caveats in pursuing this method singularly; concurring with Kimbell (2015) who distinguished several drawbacks that subvert the case made for design thinking, including, (Kimbell, 2015) “how design thinking rests on theories of design that privilege the designer as the main agent in designing.” (p. 286) The Tridea project was conceptualised to enable and embrace dyadic relationships between the project participants themselves and the software that supports their collaborative practice. Taking the assumption that the designer is the main agent in this process is not only presumptuous but counterintuitive to the Tridea ideology.

This paper also argues that whilst design thinking is an adequate model for determining the ‘what’s’ and the ‘how’s’ of this project there is a shortcoming in determining the ‘why’s’. By mapping activity theory’s conceptual model to the author’s own design thinking framework, the resulting compendium, mediates between an established pragmatic framework for design practice and the integration of a constructivist framework for in-depth evaluation of process, application and adaptation throughout the various stages of this multifaceted project. Thereby, providing a lens for creation and analysis that removes the assumption of designer centrality and bridges a deeper understanding of *why* the social actors involved in this process utilise the Tridea platform in the manner that they do. Initially this lens will examine how Tridea is to be designed, subsequently aiding in the analysis of the supporting structures of the project and ensuring that these are adequate to provide the philanthropic and altruistic goals Tridea aims for. It is this project’s hope that if all areas have been specifically designed to adequately facilitate benevolent participation, that participants’ experiences will be rewarding, trust will be developed and both the creative and philanthropic outcomes of the activity will be fulfilled.

2.2 The Design Thinking Model

Figure 1. Winstanley, L. (2019) Design Thinking Model.

The design thinking model presented in Figure 1, illustrates a canon that has evolved over many years of creative practice. Whilst this model does not profess to be ground-breaking in terms of design thinking strategy, it does however, provide a holistic approach which encompasses personal creative strategy and, in that sense, provides a neoteric framework from which to oscillate between divergent and convergent thinking. It perhaps falls short however, by overlooking the ambiguity of the design process and, perhaps more importantly in the context of the Tridea project, (McDonnell & Atman, 2015) proves to be somewhat limited in supporting a reflective creative practice. Utilising this canon singularly would also leave fundamental questions unanswered in the evaluation of trust building, which is a pivotal aspect in ascertaining the success of the Tridea project. Determining if trust is perceived and maintained within diverse virtual teams will also enable a greater understanding of the workings of collaborative online communities and thereby provide a foundation for further trust building research in the context of creative practice. Accordingly, an alternative supporting framework has been sought out and this paper proposes a bridging representation in Activity Theory.

2.3 Activity Theory

Activity Theory, in its simplest terms, (Engeström, 1999; Leontyev, 1977; Vygotsky, Cole, John-Steiner & Souberman, 1978) provides a framework to investigate how subjects employ tools to accomplish specific objects (objectives) with the aim of analysing the actions undertaken, in order to explain why the subject conducted them in that particular way. Therefore, an activity can be classed as a system of human doing, distinguished according to objects.

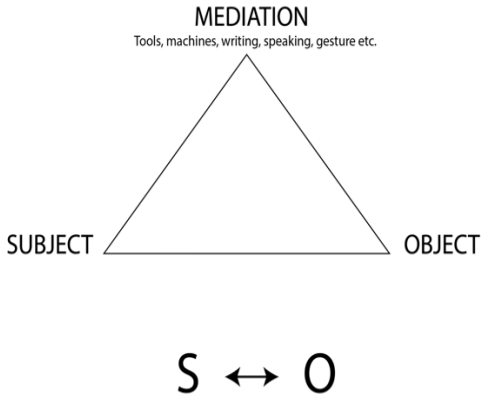

Figure 2. 1st generation Activity Theory. Redrawn from Vygotsky's Mediation Action Theory. Pronacampo9 CC BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0.

There are 4 basic principles of Activity Theory: (Engeström, 1999; Leontyev, 1977; Vygotsky, Cole, John-Steiner & Souberman, 1978).

1. Object Orientedness: Objects have their objective meaning determined by relationships with other entities in the world including the subject. An activity cannot exist without a motive; therefore, an activity is dependent on the subject-object relationship.

2. Activity Hierarchy: Activities are the highest order frame for objectives, providing a unit of analysis, whist actions and operations are lower level components embedded into activities.

   Motives - generates activity: The WHY
   Goals - results in actions: The WHAT
   Conditions - determine operations: The HOW (often subconscious)

   Considering human activity as a three-layer system initiates the opportunity for concurrent analysis within a homogenous conceptual framework. Utilising the concept of activity hierarchy may also be a useful tool to analyse how trust building fits into the participation process. Could trust initially be considered a subconscious operation; a belief dependent on conditions, subsequently transforming into a conscious action during the course of project participation? This would seem to be a reasonable hypothesis at this juncture of the project however, further investigation is required to test this theory and interpret its implications.

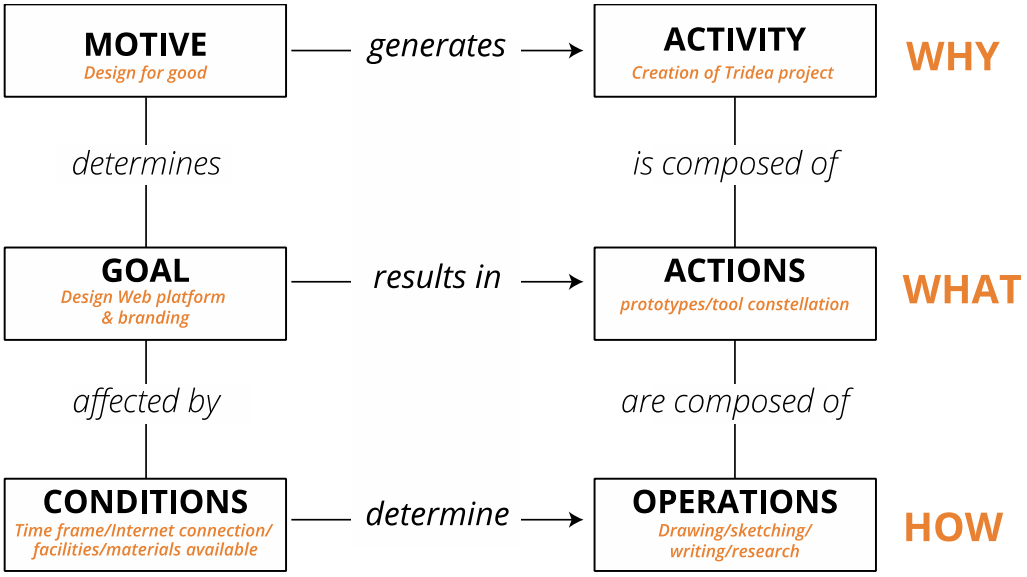

Figure 3. Activity Hierarchy of creative process in developing the Tridea Project. Redrawn and adapted from (Wilson 2006) diagrammatic version of Leontyev's (1977) original theory

3. Internalisation/Externalisation: Refers to the concept that human activities operate dyadically transferring between internal and external processes. According to Kaptelinin (n.d.) the concept of internalization primarily alludes to a point in the evolution of increased mental functions, at which sign mediation originally surfacing in the external plane ultimately advances to the internal plane. Inferring from this definition it can thereby be rationalised that externalisation is the process of transforming internal facets of an activity into external ones. For example, sketching or making notes based on internal mental constructs.

4. Mediation and Development: Tools mediate between subject and object. Performing an action through a mediating tool develops the subject. Thus, expanding what is referred to as (Vygotsky, Cole, John-Steiner & Souberman, 1978) "The Zone of Proximal Development" or ZPD (p. 84) - the difference between what a subject can

do without assistance, and what they are unable to do. Tools should therefore, be developed to consider expansion of this zone, creating a *tool constellation.* This paper proposes that it is the interplay between tools that makes this instrumentality so robust, suggesting that we are made by what we do.

2.3.1 Activity Systems

Building upon Vygotsky's concept of mediation Leontiev developed 2nd generation Activity Theory, subsequently diagramised by Engeström and expanded upon the Vygotskian triangle to include socio-cultural aspects within the model; the elements of: rules, community and division of labour (see figure 4). According to Engeström (2007) in Models and principles of Activity Theory, "object-oriented actions are always, explicitly or implicitly, characterized by ambiguity, surprise, interpretation, sense making, and potential for change." This second-generation Activity Theory model therefore, accommodates appraisal of human activity systems at a broader, macro level.

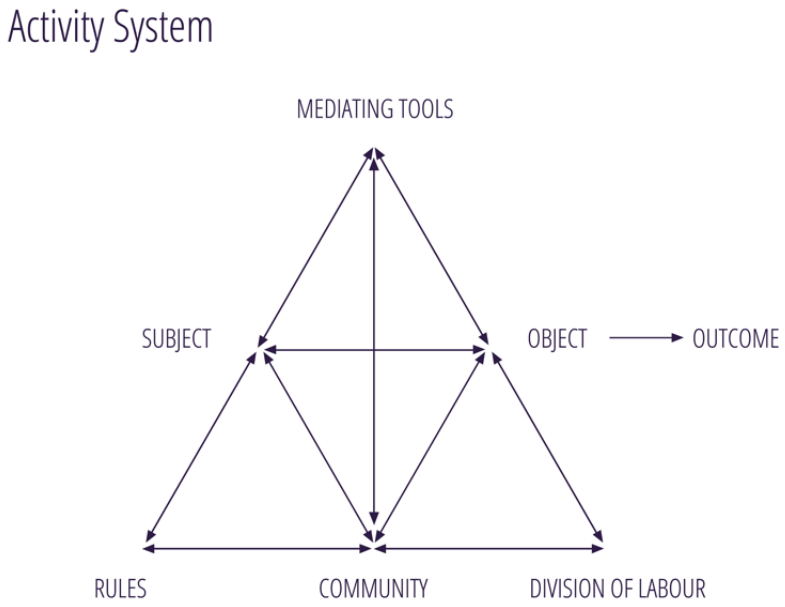

Figure 4. Lientiev/ Engeström's Second generation Cultural activity theory model Redrawn based on Pronacampo9., CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=37912658

2.4 Mapping Activity Theory to a Design Thinking Model (ATDT)

In an attempt to analyse the creative process behind Tridea and provide an analytical tool to ascertain the creative strategies undertaken, Activity Theory (AT) has been mapped to the author's current Design Thinking (DT) model (ATDT). ATDT serves as a bifold evaluative framework firstly, to determine successful execution of the creative process and secondly, at a latter phase of the project, aim to determine why participants accomplish aspects of an activity in the way that they do; in line with the consideration of human activity as a three-layer system, specifically viewing trust as a dyadic operational and action aspect of the activity.

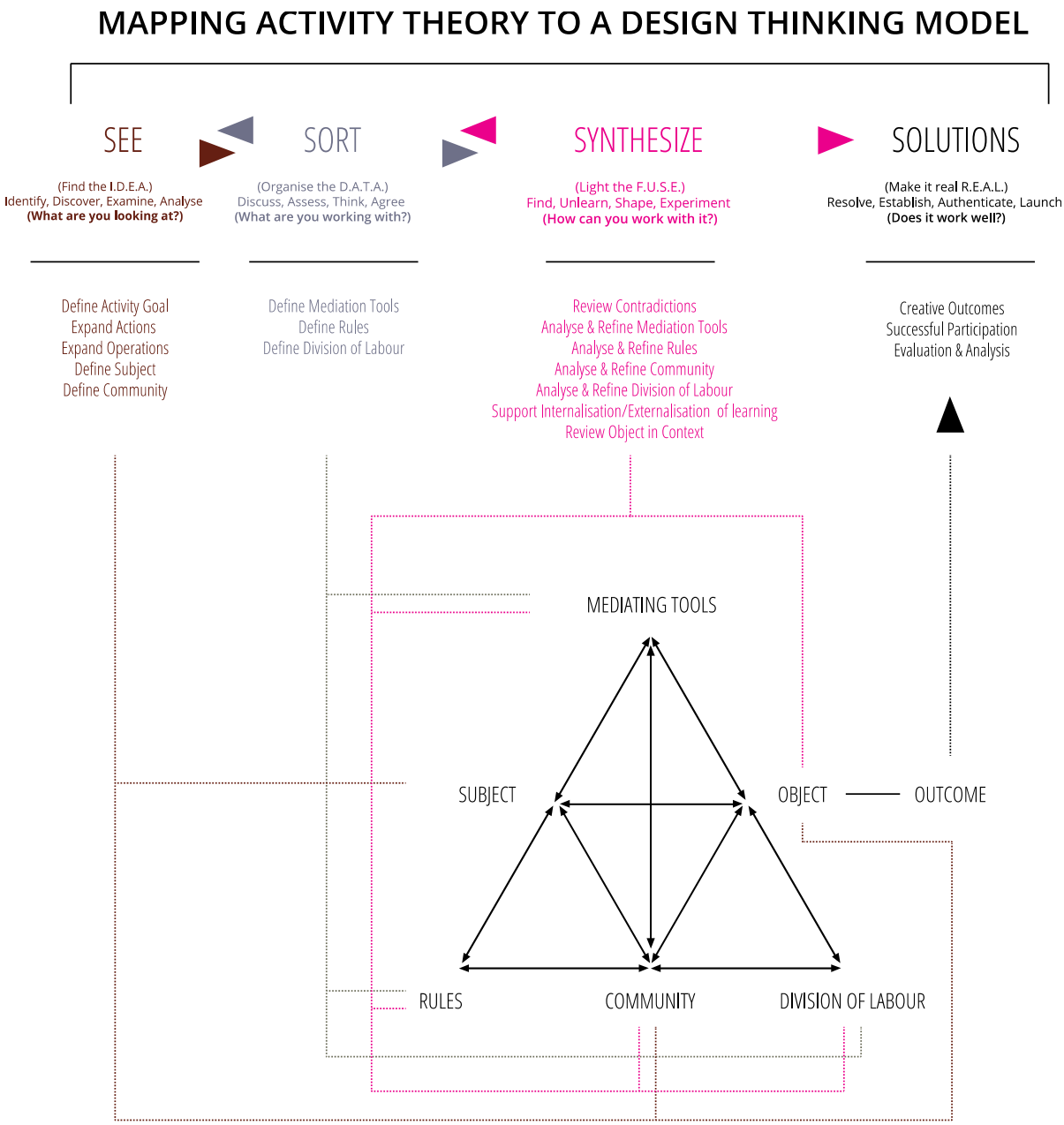

Figure 5. Winstanley, L. (2019) (ATDT) Activity Theory mapped to Design Thinking Model.

The next section of this paper unpacks methods utilised to bring this project to fruition and analyses them under the lens of ADTD.

2.5 Method In Practice

The Tridea project has been structured into four iterative design phases, “See, Sort, Synthesise and Solutions” (Winstanley, 2019) as defined in the Design Thinking model and its subsequent mapping to Activity Theory (ATDT). The *See* phase was developed in an attempt to define the design problems and prepare for potential participation issues. Utilising Activity Theory as a benchmark for preparedness whilst also acknowledging that as this is an iterative process and in order to ‘see’ clearly, this phase may need to be revisited several times.

2.5.1 Target Audience

By utilising the ATDT framework, the initial Design Thinking (DT) *See* phase has been mapped to Activity Theory (AT) in order to help determine the object-orientedness of the activity and gain insight into the macro components pertaining to its successful realisation; the first of these components being, to define the subject. Figure 6. depicts what this paper considers to be an ideal user of the Tridea website. This user persona was envisioned based on data suggesting that (Yao, 2015) the demographic of people who altruistically volunteer their time are more likely to be females in regular employment. The persona also takes into consideration IRB ethical restrictions stating that human participants must be 21 years old or over or be required to provide parental consent. The ideal user selection also coincides with this project's desire to direct the creative trajectory towards a multicultural, creative, millennial audience.

By determining a clear, discernible target audience it is this project's intention to design and produce creative collateral and a wide-ranging, mediating tool constellation that fulfils the requirements and desires of said user. Subsequently resulting in effective subject-to-object mediation and the development of trust in both the Tridea system and also in other participants' ability to effectively contribute to the project. According to BJ Fogg (2006) of Stanford University's Persuasive Technology Lab, "To increase the credibility impact of a website, find the elements that your target audience interprets most favourably and make those elements most prominent." This paper, therefore speculates that by determining the ideal user and designing the Tridea branding and web platform around their needs that this will foster the development of participant trust. With the goal to facilitate successful completion of the activity system's outcome: philanthropically and collaboratively contributing to the Tridea project.

It is also necessary to acknowledge that by defining a target audience that is open minded and philanthropically inclined, that the Tridea project runs the risk of becoming an echo chamber rather than a bridging mechanism for societal change. However, the rationale for targeting users already inclined to contribute to their community stems from the notion, not of preaching to the converted but rather, *through* the converted. Gaining proponents for the Tridea project leverages on the heuristic of social proof with the notion that building an audience of likeminded advocates will invoke the marketing phenomenon of the trickle-down effect and subsequently, the message of inclusion championed by Tridea, will ultimately reach the community at large.

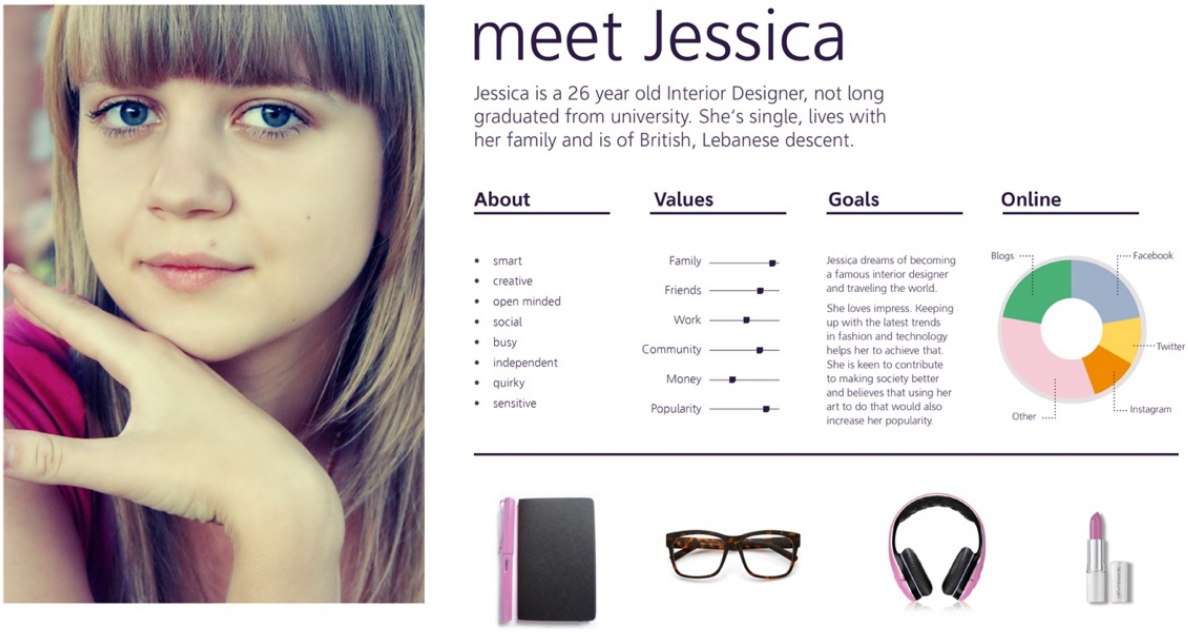

Figure 6. Winstanley, L. (2019) Tridea Ideal User Persona.

2.5.2 People and Connections

The second of the macro components identified by ATDT was to define the community. This was achieved by creating a people and connections map; adapted from a downloadable worksheet available from http://diytoolkit.org/ which was in turn inspired by an original Stakeholder Spidergram developed by the Helsinki Design Lab. (see figure 7) People positioned closer to the core of the diagram are deemed to be more influential to the project outcomes and thus this diagram serves as a visual analysis of key stakeholders in the Tridea Project. This paper proposes that by Identifying these relationships at an early stage in the project that this should provide insight into potential interactions and also highlight potential contradictions, thus offering a tool for predictive troubleshooting. This visualisation also serves as an instrument for identifying where trust relationships may be warranted for project success and in identifying these potential relationships the Tridea project can encourage and nurture connections. These theories will be appraised as the project continues to progress.

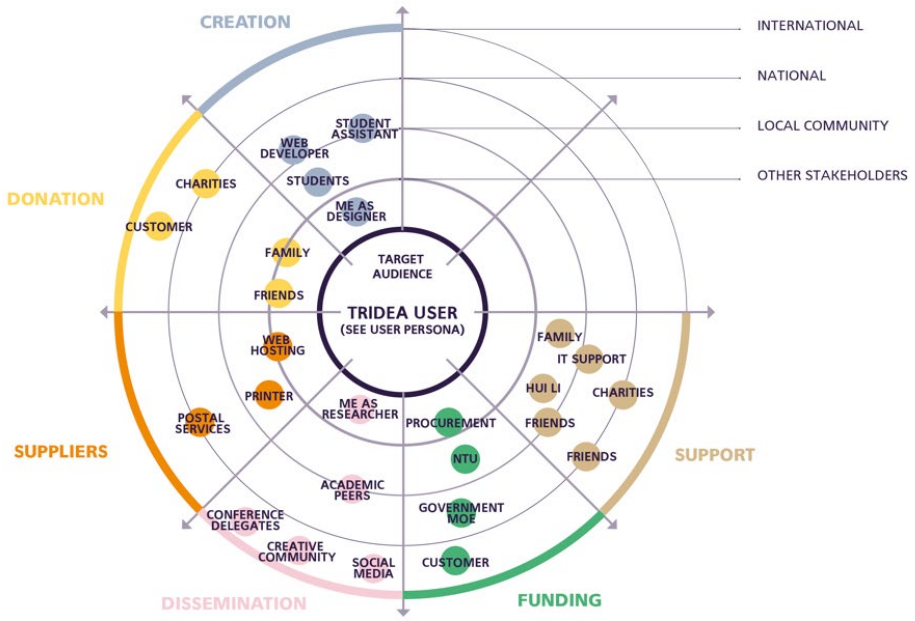

Figure 7. Winstanley, L. (2019) Stakeholder Analysis diagram created to determine and evaluate the community aspect of Engeströmian Activity Theory.

The second and third phases in the ATDT model, '*Sort'* and '*Synthesise'* (respectively) are now underway, helping to define a series of rules and inform the division of labour; alongside the conceptualisation and generation of an adequate constellation of mediating tools. It is this project's intention that the tool constellation aids in generating credibility, which subsequently fosters the creation of trust; both in the online platform and in the collaborative process itself. The third stage builds upon the findings gleaned from the second with production of mind-maps, sketches, case studies and prototype user Interface designs being created as externalisations of the Tridea activity system. This is an ongoing process and work will continue in order to develop further creative solutions designed under the ATDT lens of evaluation.

2.5.3 Mediating Tools

As previously discussed in this paper, the use of mediating tools is a key principle applicable to both 1st and 2nd generation Activity Theory. According to Kaptelinin (n.d) Tools mirror the prior experience of other subjects, which experience is accrued in the sytemic properties of tools, for example, their form or medium, alongside the comprehension of how the tool should be utilised. Hence, using tools can be proposed as a semblance of accrual and transference of collective, cultural knowledge. This would suggest that the tool constellation designed specifically for the Tridea project is a culmination of the researcher's own experience as a visual communicator and is indicative of their level of knowledge as a designer. This realisation goes somewhat deeper than an evaluation through the design thinking model alone, to evaluate the why's of this activity. This paper sees this as a fortuitous addendum to self-discovery as a creative practitioner and as an academic researcher; serendipitously aiding in developing trust in personal creative practice.

The 'Sort' phase delineated in the ATDT model supports the creation of the aforementioned tool constellation in order to facilitate effective user participation. This paper has defined a

series of mediating tools which aim to aid in the expansion of participants' Zone of Proximal Development (ZPD). These are:

- The Tridea Website as an experiential platform
- A written step-by-step guide to participation
- A Instructional *explainer* video
- Instructional emails
- A robust FAQ page
- A comment and feedback contact form
- An aggregated gallery serving as a repository
- A comment facility on all gallery images

As aforementioned, this is an ongoing process however, many of these tools are now either under construction or completed. This paper proposes that several of these mediating tools also serve as Design Boundary Objects (DBOs) According to Bergman, Lyytinen & Mark (2007) A DBO is considered as "any representational artefact that enables knowledge about a designed system, its design process, or its environment to be transferred between social worlds and that simultaneously facilitates the alignment of stakeholder interests populating these social worlds by reducing design knowledge gaps." In practical terms a DBO acts as an agent for social actors to communicate in a common language thus, providing a clear system of communication within a heterogeneous design ecology. This project anticipates that through the use of mediating tools, acting as DBOs, it may provide a transparent, user friendly platform, which develops trust as a corollary of their effective implementation.

The penultimate section of this paper will now introduce the creative aspects of this project and present the branding proposition and the user interface design of the Tridea project. All of which serve as mediating tools within the ATDT framework.

2.5.4 The Brand Marque

Under the synthesise phase of the ATDT model falls brand development and the generation of a brand marque is an integral aspect of this brand proposition. Alongside the development of a cohesive brand structure the marque simultaneously serves as a mediation tool; the subjects' initial introduction to the project's visual language, directly affecting the subjects' relationship with the object. Thus, the brand marque was created with the aforementioned user persona in mind. Conceived as both a literal and figurative representation of the Exquisite Corpse, the brand marque has been designed foremost as an animated graphic which opens to reveal the wordmark within. The static version is intended solely for print based collateral. The wordmark itself is inspired by Dada typography and metaphorically extends its regard to the Dada and surrealist movements that initiated this project's

inception. (see figure 8) It is this paper's aspiration that this recognition is successfully communicated in the visual language adopted by Tridea. To support the conceptualisation of the brand marque and in order to identify with the chosen target audience, much consideration has been given to the brand character and tone of voice presented by the Tridea brand. Subsequently the following characteristics have been selected and serve as part of the author's own mediating tool constellation, thus providing a relevant framework for analysis within the context of the author's own activity system of design:

Tridea is:

- **Creative** but not *Crafty*
- **Quirky** but not *kooky*
- **Fun** but not *silly*
- **Curious** but not *prying*
- **Friendly** but not *clingy*
- **Benevolent** but not *begging*
- **Unusual** but not *unfamiliar*
- **Challenging** but not *difficult*
- **Young** but not *naive*

Again, it is this paper's aim that these characteristics are successfully communicated in the visual language of the Tridea brand and online presence, subsequently reinforcing the credibility of the website and in turn building trust.

Figure 8. Winstanley, L. (2019) Tridea Brand Marque from the 2019 Brand Guidelines.

2.5.5 The Online Platform

Leveraging from AIGA's 2025 trends (Why Design Education Should Pay Attention To Trends, 2017) the creative aspect of this project has aimed to subsume the notion of aggregation and curation as part of the Tridea online platform. The collaborative artefacts produced by participants will be individually aggregated via a series of A.I. algorithms, which will also be programmed to create the most geographically and culturally diverse virtual teams possible and subsequently disseminate these manifold unions in an online gallery. As the author's area of design expertise lies outside that of A.I. the automated aggregation and virtual team building aspect of this project will be undertaken in close collaboration with a web developer, who has been thoroughly briefed on the socially inclusive intensions of the Tridea project. Thus, the gallery aims to serve as a repository in archiving the aggregated submissions and also serve as a gateway to the e-commerce aspect of the project where the philanthropic intentions of Tridea become more apparent. This repository forms a critical mediation tool and also constitutes a Design Boundary Object allowing subjects to communicate in a common language no matter the geographical or cultural differentiation. Work is still underway on the interface design, however decisions have been made surrounding font choices, colour pallets and supporting iconography, all of which aim to

anchor from the brand character characteristics and user persona needs and desires, as previously defined.

The final section of this paper reviews the projected outcomes and future plans for this research.

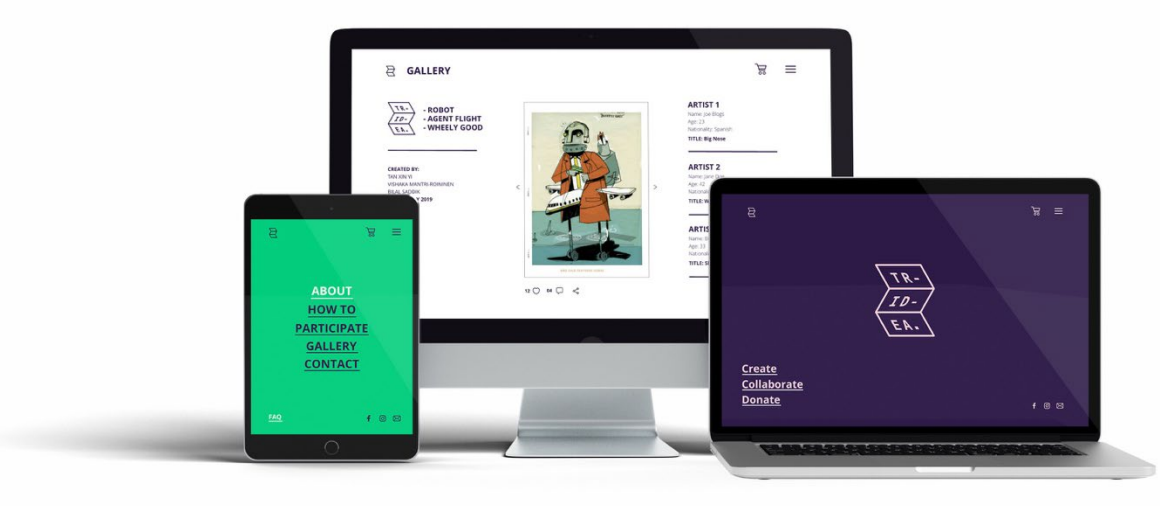

Figure 9. Winstanley, L.(2019) Tridea Online presence.

3 Plans for progression: Analysis of trust using ATDT

Chung, (2016) suggests that creating trust through geographically dispersed teams may be a challenging prospect with, “Trust being seen as a foundation for co-operation.” It is therefore, an incredibly important aspect for the continued research of this project to include an in-depth investigation on the notion of trust. There are abundant theories on the conceptualisation of trust with scholars proposing conflicting definitions. Some proffer trust as a behavioural intervention, others view trust as a psychological state (Castelfranchi & Falcone, 2010). There is also the view that trust is an attitude or willingness to take a risk (Möllering, 2006), identifying trust as a cognitive leap of faith. This research plans to investigate all these notions further in order to identify what should be considered as perceived trust within the context of this project. Reviewing its triality; trust as believe, trust as action and trust as a relational construct. This is an important aspect of the active phase of this research, which plans to gather both qualitative and quantitative data in the form of several consecutive participant surveys.

These surveys plan to pose a number of questions pertaining to the cultural aspects of trust building and also aim to provide information surrounding participants’ trust relationships within the context of geographically disperse, culturally diverse collaborative teams. Anonymity also plays a significant role in Tridea participation and questions pertaining to trusting the unknown are pertinent to this aspect of the research. It is therefore imperative for this research to undertake a thorough analysis of the conceptualisation of trust and the conceptualisation of how trust is developed, in order to form a rigorous analytical framework. From initial investigations in to Activity Theory there is positive indication that 2nd generation Activity Theory may provide such a framework. However, further research is required before this can be conclusively debated and documented.

3.1 User testing and implementation of iterative design cycle

This research is multi-faceted and alongside its rigorous theoretical underpinning there lies the fundamental visual communication aspect. Accordingly, the 'Synthesise' phase of the ATDT model intends to provide ample opportunities for the appraisal of visual language and user experience in iterative design cycles. The website will initially launch as a beta version for testing purposes and focus groups will be held to evaluate its efficacy prior to the official launch. These focus groups will also allow evaluation of *desirable design* utilising a 7 point checklist as proposed by renowned designer, Marian Bantjes (2015) as a benchmark for quality.

1. "It should arrest and hold attention
2. It should then invoke curiosity
3. It should surprise
4. It should invoke wonder
5. It should bring joy
6. It should be memorable
7. Bonus points if it's funny" (as cited in Popova, 2015)

Leveraging upon Activity Theory, this checklist will not only serve as a benchmark for evaluation but as part of a mediating tool constellation designed to facilitate the evaluation process for participants of the aforementioned focus groups.

3.1.1 Advertising and project promotion

One of the main objectives of this project is to promote the proclamation of creative practice as a form of social activism. In order to achieve this lofty goal, it has been deemed necessary to create a detailed and focussed advertising campaign with a substantial portion of the funding budget dedicated to project promotion. In conjunction with designated international charitable organisations, a strategic advertising campaign, focused around the target audience, will be designed and implemented across social media and through relevant industry publication support.

As previously discussed in the mediating tools section of this paper an explainer video will be designed and disseminated as part of the ATDT framework strategy. This video is also intended to become an integral aspect of the marketing campaign; this approach is supported by Wyzowl's annual report, The State of Video Marketing 2019, (2019) which indicates that, of the companies surveyed, 94% stipulated that an explainer video had aided in increased user understanding of their product or service. The survey (Wyzowl, 2019) also indicated that 96% of consumers had viewed an explainer video in order to find out more about a particular service. These statistics would seem indicative of the current trend toward online video marketing and its efficacy in providing credibility to new endeavours. This paper proposes that in providing a well-designed explainer video as part of the mediating tool constellation that the Tridea project will be regarded by users as being more credible and therefore deemed trustworthy. However, further research into social media advertising campaigns needs to be undertaken in order to corroborate this proposition.

4 Conclusion

This paper has presented the work-in-progress methods and creative intentions of Tridea, an on-going collaborative research project. It has identified ATDT as a framework for both design analysis and evaluation and considers this to be a sound methodological canon for

the future development of the project. The short-term goals of Tridea are to continually develop and refine the mediating tool constellation as outlined in the ATDT model and, working in conjunction with a web developer, to subsequently launch a beta version of the web platform for user testing and iterative design refinement. This paper acknowledges that there is still some way to go before there is an unabridged and cohesive design solution however, the implementation of ATDT and the creative trajectory thus far is indicative of successful outcomes.

Tridea offers a platform for design to improve society, becoming a social listener and responder and building trust where once there was none. Stairs (2005) suggests that "Altruism is already providing a sought-after alternative to strictly for-profit design practice," (p. 11) and with that notion, Tridea plans to move into the altruistic space afforded, binding together people of different races, religions, ethnic backgrounds, genders, artistic capabilities and economic situations into one creative community. As proffered at the onset of this paper, Tridea aims to contribute, not to merely consumerism, but to be part of something more; by building bridges that encourage a philanthropic approach to design-with-purpose and thus fostering a culture of creative trust.

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Polyphonic Praxis: Towards a Collective Turn in Design Pedagogy and Practice

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Design operates in a global framework but its claim to be an agent of (social) change has been undermined by a failure to deliver an authentic multivocal pedagogic practice: its homogenous neutral tendencies are, thus, at odds with a language of participation, diversity and inclusivity. In a critical approach this paper asks what role the neoliberal university's learning spaces, internal hierarchies (curricula, studios), pedagogic heritage and public platforms (conferences) play in marginalising the voices of those beyond the sphere of institutional power. The 'collective turn' is introduced as a new term for co-operative radical action, a revolutionary thematic, drawing on progress made in fine art and architecture towards more collective modes of practice and living. In a reflexive, critical and inclusive approach that is sharpened by decolonial perspectives, the foundational methodologies, myths and conditions of design pedagogy are challenged to identify alternatives. The polyphonic formation of the collective is framed here as an untapped source of power derived from a synergy of diverse participants in a collaborative and co-operative formation, similar to the orchestra. As a catalyst for change in design this paper argues that a collective sensibility and social structure provide the most generative conditions for a genuinely polyphonic praxis. Not as a 'rainbow coalition' of benign conformity in which difference is neutralised, but as a community of intent in which the conflict or tension of difference provoking a critical challenge to the very foundations of the discipline.

Keywords: collective turn; polyphonic praxis; critical pedagogy; graphic authorship; decolonial design; generative practices; orchestra

1 Introduction

Graphic design's acquisitive impulses and porous edges characterise a culture of openness and revolution, which embraces change and newness in a synthesis of (early) modernist principles and consumer culture. Ingrained into the artefacts and communications systems of contemporary life, graphic design forms a lens through which to explore the world and one's place in it. Through the widespread accessibility of digital technologies and a concomitant familiarity with graphic design's language of typeface, font, page layout therein, the discipline is also infused into the everyday lives of non-designers. The democratic emancipatory possibilities of this techno-social shift are constrained by a number of underlying impediments and contingencies, for instance, how representative of community, complex social issues and groups are the design teams who speak on their behalf?

Drawing on the critical pedagogies of Henry A Giroux (2014, 2011) and bell hooks (1994, 2010) graphic design's appetite for revolutionary change is interrogated in the context of academic curricula and internal discursive spaces (seminar groups, reviews, studio debate), public platforms and articulations (conferences, publishing, graphic authorship). Education represents a nascent site for critical reflexivity and change in design but is a far from neutral terrain, whether reaffirming the status quo or engaging in critical discourse around truth and knowledge. The attributes of collective pedagogic practice and authorship are analysed in this paper through a socio-politically accountable critical pedagogy (Prado and Oliveira, 2014) situating class, gender and race at the heart of design/ing. As Tony Fry (2010) and Dunne & Raby (2007) argue, design either reinforces the status quo or subverts it through change. Decolonial perspectives are brought to a reflexive, critical and inclusive mode of change, asking what role the university's learning spaces, curriculum and pedagogic heritage play in including or marginalising the voices of those beyond the sphere of hegemonic power. If the discipline is to authenticate its own claims as an agent of social change, the first and most radical revolution must be in design itself. A radical process of disruption, deconstruction and critical interrogation is therefore sought in a challenge to the socio-economic and political bias, embedded in its academic foundations, from the 'universal' Eurocentric influence of modernism to design's core assumptions and social structures of learning.

Dialogic in character, inclusive and open-ended this approach this is as an invitation to further discourse, which anticipates being enhanced by contributions from diverse positions and experiences. Eschewing the problem-solving paradigm of traditional (modernist) design this paper prefers a problem-setting process adapted from Donald A. Schön's (1983: 49) Reflective Practitioner. How Professionals Think in Action, described as a self-reflective conversation with a situation (Schön, 1983: 79). In Schön's (1983: 49) process, "interactively, we *name* the things to which we will attend and *frame* the context in which we will attend to them". Thus, a self-reflective (decolonial) transformation of design's historical narratives and authorship is named as the situation, framed by contemporary pedagogic practices.

First, a historical overview of design education's social production of learning is considered to unpick the pedagogic principles and practices that underpin current curricula and academic programmes. Design education's revolutionary impulse is considered within the hidden curriculum (hooks, 1994; Giroux and Penna, 1979) and neoliberal university, underpinned by an active critical pedagogy. The discursive contexts and conditions of learning are key to change because power and freedom are the cornerstones of an emancipatory education, inscribed into educational institutions and social structures (Freire, 1970, 1985).

Secondly, graphic authorship is considered as the shared or individual public voice of design: who speaks and is heard, whose voice is recorded as significant knowledge in academic learning environments and in public discursive spaces. Collective practice and authorship is explored in this proposal as an ideological shift and methodological antidote to the contingencies of current market-led forces in (graphic) design practice and pedagogy, which valorise the heroic individual, increase isolation and delimit social co-operation.

Thirdly, collective and co-operative structures in art and architecture are examined as new ways of overcoming the limitations of competitive creative practices in graphic design. Sociological insights into co-operation and collective action are drawn from sociologists

Alberto Melucci (1996) and Etienne Wenger (1999), while Harriet Edquist and Laurene Vaughan (2012) provide analysis of *The Design Collective: An Approach to Practice*. Fundamentally multivocal or plural in character, the 'collective turn' is coined to help envisage a disciplinary shift in consciousness, catalysing alternative (critical) design voices and authorship, to identify new modes of exchange and expression that exploit collaborative intelligence within more multivocal reciprocal practices. The 'turn' is deployed in its articulations as a verb (a mass social act), an adjective (collective power and responsibility), and as a noun (a pedagogic design collective) encapsulating a decisive moment of social change in the arts, architecture and local communities.

Finally, a polyphonic modality of graphic design pedagogy is proposed in which the power of multiple voices in discursive practice and collective intelligence is forged through a tension of difference, rather than the neutrality of the like-minded club of friends (Wenger, 1999). Richard Sennett's (2012) notion of the orchestra as a cooperative collective is employed as a comparative mode of polyphonic praxis. The term 'polyphonic' is employed here as a musical metaphor to invoke a richer tonality for design authorship, in a plural rather than singular formation, similar to the choir or orchestra.

2 Historical articulations of design pedagogy

The Bauhaus centenary (2019) affords educators and students of design an opportunity to critically reflect on the school's influential methods and motivations and how they anchor the discipline's intangible principles in current academic programmes and processes. The schools in Weimar (1919-1925), Chicago and later Ulm, founded by former students and tutors (1937 and 1953, respectively), helped establish modernist design's epistemological positions, universal claims and consumer capital. The significance of the Bauhaus philosophy of inter-disciplinarity was substantiated by dogmatic rules and ideological publications, from Walter Gropius and Theo van Doesburg, for instance. Other notable examples include: Jan Tschichold's (1928) *Die Neue Typographie*; Laszlo Moholy-Nagy's (1925) *Painting, Photography, Film;* Johannes Itten's (1975) *Design and Form: The Basic Course at the Bauhaus*, based on an integrated foundation teaching model (1919-1922). Such examples of graphic authorship served to legitimise and disseminate the school's revolutionary practices. Several texts and artworks have subsequently been ascribed 'canonical' historical status, exemplifying 'timeless' (neutral) typography and predominantly functional design forms.

Notions of design's neutrality persist as traces in design discourse and pedagogic practices embodied in a utilitarian aesthetic, exemplified in Beatrice Warde's (1932) essay 'The Crystal Goblet or Printing Should Be Invisible' treatise on clear typographic communication: "Type well used is invisible as type, just as the perfect talking voice is the unnoticed vehicle for the transmission of words, ideas". However, a visual language of neutrality, disguises authorship and subjectivity, which become inscribed into tropes of modernist design, such as sans serif lower case type (Tschichold, 1928), and the truth of photography (Moholy-Nagy, 1925). Francisco Laranjo (2018) insists that modernism's universal principles not only reinforce the North Atlantic axis of control over design practice and discourse but enable designers to distance themselves from the socio-political implications of their visual messages. Decolonising Design (2018: 78) go further by arguing that "the condition of modernity has concealed, destroyed and denounced all other forms of thinking". The

discipline's educational heritage masks an occidental hegemony of design's vocabulary that silences marginal voices and delimits non-western epistemologies and pedagogic practices (Ansari, 2019).

Despite professing egalitarian access to art and design education for both sexes, certain disciplines were fundamentally gendered, exacerbated perhaps by a white male-dominated master-apprentice tutor-student dynamic? For instance, women were debarred from studying all subjects at the original Bauhaus except those considered suitably 'feminine', such as weaving and pottery. Traces of the Medieval guild system based on the prestige and authority of the master as a highly-skilled practitioner of his trade can still be found in the design classrooms/studios or tutor groups today. Critical pedagogies developed by Henry A Giroux (2011, 2014, 2018), bell hooks (1994) and Ivan Illich (1970, 1974) from the foundational work of Paolo Freire (1970, 1985, 1993) are particularly concerned with reconfiguring the traditional teacher-student (master-apprentice) relationship. Here, the teacher is the active agent (the authority who knows), and students are the passive recipients of the teacher's knowledge (empty receptacles to be filled). Freire (1993: 49) describes the process of learning by rote as 'banking', an unquestioning flow of information from tutor to learner, negating "education and knowledge as processes of inquiry". Students are framed as adaptable and manageable: a bourgeois educational model of *adjustment* that reinforces homogeneity and neutrality (Illich, 1974; hooks, 1994; Giroux, 2011, 2014). Education may be socio-economically transformative for many students, but power is commonly embodied in the authority of the tutor in the classroom/studio, the assessment and progression process, and the course reading lists where certain histories and voices are given primacy. The next section looks at how external market forces shape internal institutional frameworks in the neoliberal university, reproducing limitations on the vocal expressions of the marginalised and less privileged (hooks, 1994).

3 The neoliberal university

Art and design education has always been linked to professional practice and the societal or commercial agendas that frame their methodologies and priorities. With the expansion of design education as a commodity, capitalist values and neoliberal marketisation of knowledge now shape the curriculum and the social space of learning. The reductive tendencies of mainstream commercial design have led to entrenched socio-cultural norms and a monovocal visual language (Helfand, 2001). In its aggressive colonization of everyday life, a market culture of standardisation and competition is as embedded in educational institutions as it is across all levels of society: as critical discourse has diminished, conformity and neutrality have increased.

Bureaucracy and excessive auditing have become central features of post-Fordist education, which is evident in the rigid programmes, increased administration, and a preference for metrics and surveys (Fisher, 2009: 79). 'Value for money' is now written into the UK's Higher Education and Research Act (McRae, 2018), despite its undefined status. A primary issue for the (right-wing, UK) media, 'value for money' obviates discourse around cooperation and collective power, framing education within a neoliberal vocabulary of common sense, which attacks all forms of social agency antagonistic to market values (Giroux, 2011, 2014). The capacity to co-operate with those who differ is exponentially delimited in the academy as it becomes atomised, aligning itself with a labour market characterised by socio-political

imbalance and precarity: “superficial relations and short institutional bonds together reinforce [this] silo effect” (Sennett, 2012: 8). Education is reframed in this paper, not as a ‘reflex’ of the labour market but as an act of critical thinking and transformation through collective action (Giroux, 1985: xi).

Isolated modes of professional practice and education have become the dominant routes to validation, recognition and commercial success: a paradigm that is dependent on competition rather co-operation or collaboration within academic institutions. Individualised journeys through education and practice are reinforced by the design press and awards system, underpinned by a “neoliberal ideology [that] emphasises winning at all costs” (Giroux, 2014: 9). This is counter to the reality of design as a collaborative practice: as Adrian Shaughnessy (2016: *np*) argues in ‘Collaborate or Die’, “If you want to function as [an effective] practitioner, you need to learn the dynamics of ensemble performance”.

3.1 The hidden curriculum

The hidden curriculum is an experiential by-product of learning in the social environment of the classroom or studio within which the silencing, self-censorship or denigration of ‘marginal’ positions is encoded, while remaining hidden to others. The (privileged) student feels entitled to this community of knowledge, and is empowered to exploit its attributes to transform and enhance his/her learning. The inherent inequality of this social process has deprived the economically disadvantaged, women, and certain racial/ethnic groups, an equal chance to thrive. Freire (1993: 50) describes this as a pedagogy of oppression because it “attempts to control thinking and action, leads women and men to adjust to the world, and inhibits their creative power”. For hooks (1994: 78), the assimilation of bourgeois values that incorporate a language of subjugation, were absorbed and assimilated, not only as an uncontested truth but as a necessary form of acceptance and belonging. Such obedience to authority was underscored by an ambivalence about “institutions where knowledge was shared in ways that reinscribed colonialism and domination” (hooks, 1994: 4). The social power relations in the academic studio space are identified as a source of such inequality: “white male students continue to be the most vocal in our classes. Students of color and some white women express fear that they will be judged as intellectually inadequate by these peers” (hooks, 1994: 39).

When, a ‘multicultural’ change was introduced to hook’s educational sphere, the burden of transition from segregation to integration was placed on the black students attending a white school, not on the white students, tutors or institutional management therein. A refusal to embrace and affect change by the dominant patriarchal elite resulted in a collective backlash, resulting in tactics of belittlement or ostracization, applied with the intention of dissuading staff from shifting their mind-sets and methods to enable a true paradigm shift (hooks, 1994). The neoliberal university’s urge to sustain harmony in the classroom, to establish ‘benign cultural spheres’ conforms to a conservative and liberal perversion of the progressive vision of cultural diversity (hooks, 1994: 31). Giroux (2014: 38) describes insidious constraints on teachers’ critical freedom in US schools by citing legislation that bans critical thinking lessons and ethnic studies, while removing those teachers who are deemed to have too-heavy an accent. Thus, constraining the tutor to a state of powerless silence. From the racial bias (Breland, 2016) of facial recognition and the gendered inequality of computer programming (Hicks, 2018) to the visual language of publication design and advertising, graphic design is susceptible to the geopolitical subjectivity of the designer him/herself.

Today's students are increasingly framed as knowledge consumers, reproducing the established order of control and conformity, often unwittingly reinforcing social stratification (Illich, 1974; Fisher, 2009). By unpicking (graphic) design's historical narratives and pedagogic practices, the academic power structures that shape thought and facilitate change in corporate and social spheres, can be challenged and alternatives proposed (Ansari, 2018). Monovocal design discourse may be entrenched in the subtle or more explicit social inequalities of the neoliberal university, yet the discipline's inherent embrace of revolutionary language means it is – conceptually and theoretically, at least – amenable to change. Agency is manifested in the intellectual and creative freedoms afforded by the traditional university: not only in the freedom to make, think and speak but significantly the freedom to ask why, to disagree, disrupt, and transform. From the foundations of design knowledge and pedagogic tradition, to the critical spaces of the neoliberal university, collective agency is proposed as a new way for designers to overcome the coercive tendencies and socio-political bias of the hidden curriculum.

The individual and collective voice of design is considered in the next section in relation to graphic authorship: an umbrella term concerning the originality of works devised and disseminated without the need of a client, including published writing (academic journals, blogs, design press) and conferences/festival presentation. By embedding critical reflexivity into the social structures of learning as an intrinsic part of the process the *need* to have a voice is transformed into the *right* to have a voice (Freire, 1985: 51).

4 The neoliberal university

Graphic authorship has occupied a contested position on the edges of the discipline, since a surge in critical practices in the 1990s, as graphic designers became more vocal about the politics of design, its role in contemporary consumer culture, and social responsibility according to the Womens Design + Research Unit (WD+RU, 2015). Post-modern critiques of graphic design's modernist sterility and uniformity centred on its distance and disconnection from an increasingly complex world. In response dynamic complex visual and intellectual alternatives emerged during a surge in critical practices in the 1990s, while designers adopted the role of critic and author. The voices of radical change failed to capitalise on their presence in the critical sphere, lacking the collective momentum needed to instigate deep long-lasting transformation. Design soon returned to a corporate modernism that had proved so successful in an increasingly globalised design culture. For Jessica Helfand (2001: 42) this is defined as: "Minimize difference. Maximize reproducibility. Make it easy, accessible, understandable to all. This is the univernacular: ultra-homogenized and distinction-free, the international language of the status quo."

Authorship privileges the voice of the speaker and legitimises the subject of debate – its conceptual field and geopolitical references – but also implies responsibility to interrogate the framework through which expression, access, and identity are made possible. As the tools and technologies of visual communication have infiltrated every sphere of public and private life, a process of digital democratisation has facilitated greater graphic authorship through a global community of educators, amateur bloggers and professional practitioners. The new global reach of communication technologies has enabled the local community to operate on a vast geopolitical scale, connecting disparate like-minded people facilitating change. By exploiting the power of the many mistrust in moral responsibility and delivery of

social needs by big corporations and (local) governments (Vaughan, 2012) is expiated. The number and frequency of voices has increased, but greater volume has not been accompanied by greater value, neither in terms of critical reflexivity nor diversity.

In the social production of knowledge, public platforms, such as Wikipedia have implications for historical truth and visibility, yet a clear gender bias is found: “just 16% of the site’s volunteer editors are female and only 17% of entries dedicated to notable people are for women” (Cecco, 2018). As such, each new narrative of world events or human endeavour, continues to be framed by and carried forward by men: a mode of domination, in which “power, technology, and ideology come together to produce forms of knowledge, social relations, and other concrete cultural forms that function to actively silence people” (Giroux, 1985: xix). From classrooms (hooks, 1994) to conferences, those given space to speak, or who express themselves freely, unafraid of censure, tend to be from a very narrow demographic.

> When a conference organizer gives a designer the opportunity to speak on stage, it’s a statement that their perspective is of value to the design community. If the majority of those given the stage are men, the implicit suggestion is that the most valuable perspective is that of a man’s. (Eye on Design and Notamuse, 2019)

What the Eye on Design and Notamuse (2019) team discovered in their research into female contributions at design conferences was not only the low percentage of speakers but also the comparably short time they were given on stage compared to male presenters. The proportion of female representatives, they noted, was often a third or even a quarter of the total. Even when an equal number attended, men were given sole use of the stage, while women tended to share the platforms with other speakers. The conclusion they came to, despite claims of cutting edge line-ups of innovative and international leaders from the sector, is a comprehensive lack of inclusivity. The design community has done little to address the marginalisation of women’s voices, or the gendering of new technologies. Feminist Studies and visible action have made inroads towards redressing this im/balance of authorship and pedagogic practices (hooks, 2010) yet inequalities persist through the hidden curriculum (Illich, 1974), and in patriarchal-historical narratives of design. A counter-cultural impetus to many collectives (Vaughan, 2012: 14) of which the feminist collective is a worthy subject of research (See Red Women’s Workshop, 1974-1990; Matrix Feminist Design Co-operative, 1980-1995; muf, set up in 1994;). Substantial enough to merit distinct modulations of the collective as an inherently familial space, the collective arguably forms a logical and necessary social support structure for women over the centuries.

Exclusion represents a subtle form of hegemonic control in design’s public domains, as Prado and Oliveira discovered when their proposal for a paper on ‘Decolonizing Design’ was rejected by an international design conference (2016), inspiring the formation of their critical research collective. The Womens Design + Research Unit (WD+RU, 2015: np.) was similarly formed (in 1994) in response to “a highly visible male dominated graphic design profession” at an international conference line up. Provoked by the exclusion of prominent female design speakers, WD+RU (2015: np.) sought to create spaces for conversations to take place, “where people could feel empowered and contribute to an emerging discourse on design and feminism”. In the performative theatre of the crit, review, pitch and presentation, the design student encounters power systems which he/she is either able to exploit to progress, or is excluded. A critical interrogation of design’s monovocal tendencies at conferences,

studios and platforms exposes not only the limitations of market-driven discourses around design, but also the politics of domination that are produced and reproduced in the educational environment: “Making the classroom a democratic setting where everyone feels a responsibility to contribute is a central goal of transformative pedagogy” (hooks, 1994: 39).

A transformation of graphic authorship from a singular voice to research-led collective articulations characterised by a polyphonic praxis is sought. By individualising public life, human experience and education, Fisher (2009) argues that capitalism seeks to reduce the social power of community. In the next section collectivity is outlined as a more progressive social model of cohesive diversity, coalescing difference in collective social structures, in relation to more established movements in fine art and architectural practice.

5 A Collective Turn for the Design Community

Through inter-dependent social configurations the design collective represents a radical model of communal power: a multi-vocal process of design formulating participatory connections between stakeholders and communities with a more socio-political purpose. Recalling Schön’s (1983) problem-setting method, the collective design group/agency is defined as a ‘situation’ which enables a field of shared action (Melucci, 1996: 16). Collective action is framed as “the presence of decision-making mechanism, the setting of goals, the circulation of information, the calculation or outcomes, the accumulation of experience, and learning from the past” (Melucci, 1996: 17). A knowledge-commons or collective intelligence is, thus, formed in the process. Collectivity facilitates a dispersal of power from a hierarchical pyramid effect to a more multi-vocal mode of teaching and learning in the socio-political structures of design education and practice. Collective action is not by definition socially beneficial or benign, as the global rise in populist politics and right wing rhetoric demonstrates. The European surge to the right is characterised by a drive to exclude and divide in an ‘us’ and ‘them’ contest, based on national purity, economic or ethnic cleansing and sexual orientation (among many issues). What is needed, according to Melucci (1996) is a shift in the language used around collective sensibilities: to devise and describe new methodologies and mind-sets, with social justice at its core. In similar terms to an engaged pedagogy (hooks, 1994), collective action is defined as:

> a process continuously activated by social actors… Providing an account of the plurality and tensions constituting a collective actor, collective identity, is a cognitive tool for this learning process (Melucci, 1996: 62-63)

Yet in adjusting to meet the dominant culture of a social group, the community of practice may inadvertently adhere to a bourgeois pedagogy of neutrality in which sameness rather than the tension of difference is sought. As a collective social learning system, Wenger’s (1999: 14) communities of practice are, not merely a club of friends or a network of connections between people, but formed by “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly”. Through collective belonging and a flattening of (horizontal and vertical) power-relationships at university the students’ sense of agency is awakened and collective action is provoked. Working within/beside institutional systems (curriculum, timetable, self-managed time) the collective is challenged to reconfigure their own motivations and pressures within the course and college.

To design is to immerse oneself in a process of participatory material production, involving negotiations between and within a multiplicity of agents, human and nonhuman alike (Miessen, 2016). Miessen argues that the term 'participation' has become increasingly overused, it has morphed into a mode of neutralising difference, similar to hook's (1994) 'rainbow coalition' of benign conformity. What we need is a new mode of collaboration that goes beyond consensus: collective critical action is proposed as one antidote. A language of participation, community and collaboration now dominates discourse around public cultural institutions such as art galleries and museums, mirroring a shifting focus in fine art and architecture emerging from a relational model of practice. Participation in itself encourages co-creation but does not prevent socio-cultural bias of the kind identified in the hidden curriculum. Art and (graphic) design have always been interactive in the sense of sociability and dialogue, what new technologies and social media have added to the exchange is an emphasis on the significance of participation. Etienne Wenger's (1999) theory of inter-personal participation, has helped inform meaning making in the techno-social practices of design pedagogy.

> Today's complex problem solving requires multiple perspectives… We need others to complement and develop our own expertise. This collective character of knowledge does not mean that individuals don't count. In fact, the best communities welcome strong personalities and encourage disagreements and debates. Controversy is part of what makes a community vital, effective, and productive. (Wenger, et al: p.10)

Sennett (2012: 15) also describes collective co-operation as a cohesive *conflict*: "weaving together these differences is like conducting a rich conversation". The shape and voice of each collective is determined by the participants' skills and preferences, the immediate environment of the group's formation, and its underlying aims. By repudiating the dominant narrative of individual genius, the collective creates more space to think through social relations, to manipulate or subvert expectations of success, and to bring about cognitive change. In most design disciplines co-operation and collaboration are intrinsic to the process and realisation of ideas and artefacts but, while co-operation can be defined "as an exchange in which the participants benefit from the encounter" (Sennett, 2012: 5), collectivism offers design a new, more polyphonic direction. Internal (academic) and external (professional) structures are considered next as mirrors or exemplars for future modulations of pedagogic practice: the social relations of power, discipline and coercion that shape student experience in the hidden curriculum if they remain unchallenged may be repeated and reinforced within design studios and client relations.

5.1 Collective Authorship

The collective is framed here as a 'community of intent' (Vaughan, 2012), which reflects more accurately the social reality of its audience and works *with* them. Internally inclusive marked by dialogic discourse reflecting the uncertain space in which design is developed, produced and disseminated. The dialogic 'counter-hegemonic' (Kester, 2004: 115) challenges "dominant representations of a given community and [helps to] create a more complex understanding and empathy" with the broader public (Dodd, 2012: 62). An internal-external discourse opens transmission to more convivial or hospitable modes of giving *back* in an "exchange of authorship or creative" (Dodd, 2012: 62). As an example, Tania Bruguera's recent Hyundai Turbine Hall Commission for Tate Modern (London) in 2018 "seeks to revive collective social responsibility and common purpose through deliberation and public commitments" with Tate Neighbours (Tate, 2018). Dialogic in approach, the

artist worked with the community living adjacent to the gallery to devise a manifesto and ‘Terms and Conditions’ (Tate, 2018), inviting more neighbourly action from those visiting the gallery and using Tate’s free WiFi:

> We advocate for the right for all to be different but equal. We believe that oppressed communities contribute culturally, socially and politically to the betterment of all. In times when thoughts and words are not enough, actions must become our common language.

In addition to the collective local voice being embedded in the gallery’s digital portal, the most notable action in the public domain, emerging from the commission has been the renaming of Tate’s Boiler House (for one year) in honour of local activist Natalie Bell. Assemble (founded in 2010) became the first collective to win the Turner Prize in 2016 for their work across art, design and architecture, in collaboration with a local community in Liverpool. The field of this collective action is *internal* (within the group itself) and *external,* within social contexts, which are open and participatory. Assemble’s collective system is connected for socio-economic benefit with flexible team members activating the multivalent touch points required for the audience or local community, in a similarly reciprocal approach to Brughera and the Tate Neighbours’ collaboration (Tate, 2018). There are diverse motivations for collective practice in the arts and design. For the Guerilla Girls’ fluid membership (formed in 1985), anonymity has been exploited as a strategic rejection of individual identity in a corporate art market that explicitly preferences male artists. Pseudonyms (usually of dead female artists) are adopted and gorilla masks worn to produce and reproduce the collective ‘brand’ while enjoying the freedom of their alter ego’s voices. By deferring attention from the artist under the mask the collective’s messages gain primary significance.

Mattias Muller (Muller, et al, 2017: 37) links historical models of shared/communal living to the emergence of a social movement embracing collectivity and a sharing economy in architecture. Sharing resources at micro and macro levels, amongst a local group or via online networks (such as Airbnb, sofa surfing, flat swapping) represents a shift in social values away from individual ownership, which Muller *et al.* (2017: 37) argue is due to “changing demographics and the renaissance of the city as a hub for a collectivity”. In a crisis-orientated culture, a collective sensibility and social structure provides the most generative conditions for polyphonic design praxis, whether in response to socio-economic austerity, urbanism (architectural collectives), the patriarchal bias of market forces controlling creative recognition (Guerilla Girls) or the socio-political inequalities of higher education. In an adaptable formation each collective is able to unmake and remake itself, determined by the ‘causal relationships’ in each group: the dynamics of the relationships in the group define the shape and purpose of each group, participants seek to learn more than they currently know, together. The collective is a social site in which difference is assembled to facilitate creativity and inspirational discovery produced by creative and collective participation in a ‘constant becoming’ (Wenger, 1999: 151). Instead of pitting students and design practitioners against each other in a battle for (high) grades, awards, opportunities to win, the adaptable social structure of the collective benefits the individual *and* the group.

6 Polyphonic Praxis

Polyphonic praxis is defined simply as a multivocal theory for design explored and tested through practice and pedagogy, followed by analysis and reflection: an action, a group of distinct voices and a democratic social structure for critical and creative practices, simultaneously combining a number of parts, each forming an individual melody and harmonizing with each other. In this context, the processes of discourse and the social production knowledge are framed as meaningful, independent outcomes. Staff and students are both actors in the structural organisation of the collective, co-researchers in the productive philosophies of the socio-creative unit: defined as reflexive, critical and inclusive. Critical discourse interrupts the efficient consumption of information, seeking to unsettle and destabilise “forms – diffused, naturalized, and habitual – that instil colonial relations of power” (Schultz, et al., 2018: 3). A critical consciousness facilitates active learning in an emancipatory transformation through collective political struggle, which occurs alongside more explicit formal teaching and learning methods. Tutors must share in the responsibility to invoke change by preparing the social space of learning, attentive to the underlying bias of tacit knowledge and the hidden curriculum. In this context collaboration and co-production are framed as “both a methodology and a political position” (Vaughan, 2012: 10). In the discipline’s globalized territory, public debates have for a long time used ‘multicultural’ and ‘diversity’ as badges of ethical authenticity, yet biased attitudes, ideologies and philosophies persist within capitalist discourse which neutralises in the process of naming and claiming autonomous difference. Can or will academic programmes and procedures adapt to address socio-cultural and economic bias in classrooms, methodologies – or is a radical disruption needed as Decolonising Design (2018) suggest?

In promoting the value of a polyphonic modality for design, an adaptable set of terms and tools is required to describe and inscribe new discursive terms of engagement within a collective ‘turn’, which exploits the creative potential of diversity (Vaughan, 2012: 15). The polyphonic modality of design authorship and articulation is distinct from hook’s (1994) ‘rainbow coalition’ in which difference is neutralised, leading to inequalities and a monovocal culture. Sennet (2012) frames the orchestra as a co-operative group endeavour in which each member has a key role to play independently, which is then transferred to the collective project at rehearsal wherein different voices or performers coalesce. New labels and alternative terms must be applied with a critical consciousness to the sphere of design discourse lest the names lose their independent significance as another adjunct (Decolonising Design, 2018), a catchy heading for an institutional rebranding exercise.

The collective ‘turn’ is dependent on radical change from all those who hold power: a transformative praxis of “reflection and action directed at the structures to be transformed” (Freire, 1993: 126) because authorial aspirations may end up reinforcing conservative notions of design production and subjectivity. The collective value of design must be introduced to students through a reconfigured curriculum, assessment processes which value the collective, artefacts and messages that give a critical voice and visual form to polyphonic design. In the classroom/studio, attention to who is speaking, what position is being taken and on whose behalf, must be framed as core concerns rather than as additional or liminal interests. With greater socio-political consciousness, the classroom/studio is envisioned as a site where new knowledge, the experiences of students and teachers alike, is produced through inclusive dialogue, not only in terms of voices heard,

but also in decolonised historical narratives of design (hooks, 1994). New foundations and formulae are fundamental to the ethical, intellectual, critical and social integrity of design.

7 Conclusions

The immaterial values and political undercurrents of our world are inscribed into historical accounts of design as epistemological truths, embodied in its artefacts, aesthetics and pedagogies. Design pedagogic practices are therefore significant spaces for formulating or questioning the discipline's ideologies and epistemological boundaries. Through critical reflection on the socio-cultural strata of design history and discourses a bias towards neutrality is revealed, reinforcing universal worldviews of design, which are fundamentally eurocentric.

The pedagogic design collective is conceived as coalescing the value of different voices from tangential backgrounds in a polyphonic praxis in a shared form of graphic authorship. In the design studio or conference stage, greater polyphony is best delivered from a collective sensibility and social structure. However, any alternative form of pedagogy, progressive notion of learning must be accompanied by pedagogical relationships marked by dialogic questioning, communication and transformative action (Giroux, 2012: 38). The emergence of collective social power explored in this proposal is framed as a methodological antidote to the homogeneity and monovocal tendencies of current market-led practices in (graphic) design practice and pedagogy. Within the collective, more generative plural modes of design discourse can be developed by the inter-dependent nature of collaborative practices, which work to disrupt the centre/marginal, mainstream/alternative dichotomies of capitalist culture and the neoliberal university. Both design's history and its future can be unpicked and remade, by disconnecting and redirecting the discipline from established matrices of power inscribed into the hidden curriculum (hooks, 1994; Decolonising Design, 2018).

This paper has examined cooperative and collaborative alternatives to design's entrenched culture of competition and drive to win awards and big client contracts, that ultimately diminish genuine difference and diversity. For Freire (1970) and hooks (1994) academia has fundamentally failed in its promise of authentic social mobility and multicultural emancipation. Within complex socio-economic conditions, this is partly due to the dominant authority of the (white male), who produce and reproduce socially-biased power structures orientated towards hegemonic norms; partly due to the Eurocentric orientation of (modernist) design aesthetics and principles; partly due to the inherent privileges and marginalisation of voices in the hidden curriculum.

The collective is framed as an untapped source of agency and impact derived from a synergy of diverse participants in a collaborative and co-operative formation. The collective social structure goes further than participation and co-operation by seeking the tension of different voices. 'Polyphony' is employed, here, as a term for disrupting compliant bourgeois notions of 'diversity' in academia, initiating a shift in focus, from the heroic individual, to a collective articulation of the discipline's social and intellectual possibilities. Sennett's (2012) notion of the orchestra is framed as an adaptable collective model for design, in which distinct voices coalesce in a shared endeavour. But, more models of the design collective are needed, to disrupt the imbalances of power and expression within academia and professional practice. Without a radical reconfiguration of (critical) design practices, from its

foundational pedagogic frameworks, a polyphonic modality of new design voices in the discipline will remain as superficial as the next paradigmatic change.

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South Side Speculations: Designing Public Histories & Public Futures on Chicago's South Side

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Competing historical trajectories of radical urban innovation and debilitating racial oppression can be vividly seen in the racial and economic disparity of contemporary American cities. As America's third largest and most segregated city, Chicago is a prime example. This paper documents the methodological contributions of design research, education, and practice to an interdisciplinary curriculum delivered over two summers to adolescents from Chicago's South Side. The interdisciplinary team worked with African American and Hispanic adolescents to share and practice methods from oral history, Speculative Design, and various forms of narrative and media production to address issues of race, health, identity, and individual and collective agency. In this configuration, History, Fiction (Literary and Media Studies), and Design came together to generate new perspectives on the past, present, and future of specific neighbourhoods, grounded in local history and politics. The twenty-three participating adolescents worked through the two summers of workshops to produce multimedia public histories in the first year and speculations for futures of healthier neighbourhoods in the second year. In this process, young people used various design methods to project themselves into their city's future, generating new social identities and new sites for discourse on forms of structural violence faced by residents of Chicago's South Side. By centring young people of colour in critical, creative practices of constructing future scenarios, their perspectives on issues of race, health, agency, identity, and social desires are cast in relief to join extant discourses on urban futures.

Keywords: speculative design; interdisciplinary pedagogy; design education; public history; urban futures

1 Introduction: Chicago's South Side

The city of Chicago has played significant roles in American history and the development of American social identities. It has been the birthplace to technological innovations that have transformed the nature of urbanism, including the first steel-framed "skyscraper" (1884) and infrastructural marvels such as reversing the flow of the Chicago River to improve public health from waterborne illness (1900). Chicago captured the world's imagination with its infamous "White City" at the World's Columbian Exposition (1893), exporting architectural and infrastructural ideas that re-imagined what a city could be.

Between 1915 and 1970, approximately six million African Americans—most descendants of slavery—fled the severe racial oppression of the American South in search of better living

conditions and work opportunities in Northern and Western states. Chicago became a major destination of this exodus, known as the Great Migration. Chicago's black population swelled from 2% of the city's residents in 1890 to about one-third in 1970, with the vast majority settling in communities on Chicago's South Side (Layson & Warren 2017). While northern American cities did not adhere to the Jim Crow laws of racial discrimination in the South, discrimination and segregation were legally enforced in other ways. Policies such as "redlining"—discriminatory lending policies that effectively prohibited people of colour from buying or renting in many neighbourhoods—effectively restricted African-Americans to narrowly confined areas of the city (Squires, et al 1989). These practices have had multi-generational impacts.

Today, Chicago is America's third largest city and its most segregated (Grabinsky & Reeves 2015). Competing historical trajectories—incredible innovation and debilitating racial oppression—can be seen vividly in the city's contemporary racial and economic disparity. That disparity is evident throughout the predominantly African American neighbourhoods of Chicago's South Side, which have the city's "highest rates of school dropout, obesity, commuting times, drug arrests, and incarceration" (Bennett, et al 2018). Beneath short-focused media attention to issues of interpersonal violence lie powerful underlying structures of institutional and infrastructural violence. Inextricable historical forces have produced an urban environment in which black and Hispanic residents of Chicago's South Side are entangled in systems that exercise structural violence upon their economic, physical, and social well-being. Yet, against overly simplistic narratives of victimhood or resilience, this is one of the largest contiguous African-American communities in the United States with a vibrant history and contemporary culture.

1.1 Transmedia Collage

Starting in the summer of 2017, a team of historians, literary and media scholars, designers, journalists, artists, and activists kicked off a two-year collaboration with twenty-three adolescents from Chicago's South Side to document racial barriers to health and imagine healthier futures. *Transmedia Collage* set out to document "a climate of structural violence [that] has impacted the health and well-being of black and brown teens and the communities in which they live on Chicago's South Side" (Bennett, et al 2018) through a pedagogical model of community engagement. This collaboration was undertaken by two research organizations with different institutional affiliations: the Transmedia Story Lab at the University of Chicago, an initiative that "explores how emergent digital media can provide a platform to promote creative practices among youth of colour, influence broader publics, and improve health," and History Moves, a platform for producing community-engaged public histories through participatory design, directed by researchers from the University of Illinois at Chicago Gender and Women's Studies program, Department of History, and the University of Cincinnati School of Design.

The interdisciplinary team worked with adolescents from specific neighbourhoods on Chicago's South Side, including Englewood, Greater Grand Crossing, North Lawndale, Washington Park, and Woodlawn. These young people learned and practiced methods from oral history, Speculative Design, and various forms of narrative and media production to address issues of race, health, identity, and individual and collective agency. In this configuration, History, Fiction (Literary and Media Studies), and Design came together to generate new perspectives on the past, present, and future of a place, grounded in local history and politics.

The two-year curriculum and its resulting media productions—collages, speculative prototypes, and short films—were displayed in multiple public venues on Chicago's South Side in 2019. These exhibitions were accompanied by programs that brought together residents, scholars, participating young people, and local activists to engage the works produced as new objects (and sites) of discourse for the city and its residents.

This essay articulates frameworks, methods, and outcomes of the curriculum with a specific lens on integration of design methods used. These methods are not particularly novel themselves. However, when applied within an interdisciplinary, creative, and pedagogical project aimed at expanding a specific population's capacity for generating material discourse on the future of its city, these methods demonstrate expanded potential for public engagement through design.

In particular, the design of customized tools—here referred to as a series of "machines"—to visually catalyse a collaborative design process by non-designers provided significant contributions to a trans-disciplinary curriculum. Until further applications of this curriculum can be implemented and studied, the results will need to substantiate their own validation for the methodology and context as framed. The author hopes these methods—as catalysed by the "machines"—may prove valuable for researchers engaged in similar work.

1.2 Addressing Critique: Speculative Design & its Discontents

The past two decades have seen increased interest and activity in discursive approaches to the design of material culture. This seems driven by a reflexive response to the increasingly narrow set of concerns associated with user-centred design, particularly for creating products and services in a global capitalist framework. Discursive Design has been theorized as an umbrella category for design activities that aim to inspire reflection upon substantive socio-cultural discourses, rather than for utility or aesthetics alone (Tharp & Tharp 2019). This includes Speculative Design, which tends to focus primarily on the social, economic, and political consequences of science and technology—particularly the ways in which design activities domesticate new technologies into the quotidian experiences of everyday life (Dunne & Raby 2014, Tharp & Tharp 2019).

As Speculative Design practices have grown, so too have their criticisms. A growing critique challenges its "lack of political engagement and strong activism, i.e. confronting with the 'real problems' such as … racial, class and gender inequality" (Mitrović 2018). In a similar vein, social hierarchies that often blindly folded into design practices are challenged as an opportunity to imagine a more capacious approach: "Our criticism started as more of a very immediate look at the lack of representation, the lack of non-white bodies, the depiction of women and people of colour in subservient roles."[1]

It is within this critique that *Transmedia Collage* set out to operationalize a model for engaging young people of colour in a participatory, critical and creative educational experience, facilitating high school students to research the histories of their communities, analyse their personal experiences within an historical framework, and synthesize these into scenarios that propose healthier futures for their neighbourhoods and everyday lives. By

[1] Luiz Pardo and Pedro Olivero in panel discussion with Ivica Mitrovic as part of the "Speculative – Post-Design Practice or New Utopia?" workshop, October 19, 2018, at the Museum of Fine Arts, Split, Croatia. Retrieved February 18, 2019, from http://dvk.com.hr/interactions/interakcije2016/publicdiscussion.html

blending Speculative Design with participatory historical methods, the resulting speculations were local, historically-grounded, and politically motivated.

1.3 Non-Genocidal Scenarios

One of the primary methodological tools of design, generally, is the Scenario. The practice of crafting Scenarios pairs well with literary and media studies. Scenarios "have a set of circumstances or constraints within which they occur; a plot or logic that guides how events unfold, and characters… give them a human context. But the point of the story is not to develop a more accurate view of the future; it is to enable the reader to look at the present in a new light—to see it more clearly" (Hammond, 1998). In Year 1 of the *Transmedia Collage* curriculum, scenarios synthesized historical research—through oral history and archival research—into fictional narratives informed by historical evidence. In Year 2, scenarios portrayed possible futures for South Side neighbourhoods, animated by fictional characters and the desires, challenges, and artefacts of their everyday lives. Scenarios translate evidence of the world as it is into fictional accounts of the world as it could be.

At a recent symposium on design anthropology and social justice, discussion turned to the pervasive absence of people of colour in "futures" envisioned by technology companies, designers, and futurists. Anthropologist Elizabeth Chin described this preponderance of futures of whiteness, not as an oversight but an anticipation that the "genocide" of people of colour will be complete.[2]

How do young people of colour—particularly from neighbourhoods *constructed* from structural practices of segregation—imagine technological development and the future of urban space? *Transmedia Collage* blended Speculative Design with methods from History and Literary Studies, in part, to address this question.

2 Methods: Public Histories + Public Futures

Despite this project's interdisciplinary nature, discussion is here focused on design methods used in the curriculum; namely, exercises to generate fictional-historical and future scenarios, persona ("character") development, and rapid prototyping of artefacts. At the outset, this project determined to integrate local historical, political, economic, and cultural specificities into facilitating young people to imagine radically altered futures for their own neighbourhoods. This model acknowledged that the young people participating in the project would bring their own lived experiences into the work.[3]

2.1 Public Histories: Year 1 Curriculum

During the first year, participating adolescents conducted a local public history project. They worked intergenerationally by interviewing elders living in their own neighbourhoods, sometimes including family members, to elicit first-hand accounts on neighbourhood transitions over three to four generations. They read contemporary narratives about life on Chicago's South Side from the Great Migration to the present. With guidance from public

[2] Comments made during her presentation at the symposium Rethinking Design Anthropology: Social Innovation and Social Justice. March 28–30, 2018, at the University of Cincinnati. Conference documentation available at: https://sisj2018.tumblr.com/

[3] In her approach to pedagogy as a form of liberation, bell hooks describes the classroom as a place where personal experience joins other ways of knowing: "As a teacher, I recognize that students from marginalized groups enter classrooms within institutions where their voices have been neither heard nor welcomed, whether these students discuss facts—those which any of us might know—or personal experience." (hooks 1994, pp. 83–84).

historians, they used content from their interviews to guide research into public archives for imagery, audio excerpts, media reports, and other archival evidence supporting these stories. Working in small teams, each team examined a particular historical moment in a particular neighbourhood to produce a fictional-historical narrative animating the experiences of people of colour during those times.

One team examined the 1995 heat wave that killed over 700 people, mostly due to inadequacy of infrastructure: lack of communication, evacuation procedures, and other fundamental emergency planning proved particularly deadly for vulnerable populations like elderly residents of large apartment towers. Another researched the 1980s drug war, particularly as it intersected with the unfolding HIV/AIDS epidemic. The narrative reframes the challenges of young people of colour caught up in the midst of intersecting political responses to these public health crises, which proved more punitive than beneficial. The third team researched the post-WWII period in Bronzeville, the height of the Great Migration and Chicago's “Black Metropolis.”

This approach merged historical research—through oral histories and public archives—into fictional characters, settings, and plot-lines that encouraged the young people to think about the challenges and opportunities of people of colour living through those historical moments. They also juxtaposed those experiences to their own. Each team created a collage, translating their narratives into unique multimedia forms: audio, textual, and image collages.

2.2 Historical Speculative Design: Year 1 Speculative Design Workshop

As a conclusion to the public history curriculum, participants engaged in a one-day Speculative Design workshop to prototype artefacts for use by their fictional characters. This workshop engaged young people in a speculative design process uncharacteristically oriented toward the past. They engaged core design competencies: developing empathy (designing for someone else), problem-solving (trying to improve the fictional character’s life), and working within constraints (could not make use of technologies or knowledge that did not exist at the time). Prototypes further activated the narratives as they became props which participants could use to role play aspects of their characters’ lives.

2.2.1 Sample Historical Narrative: Bronzeville, 1940s

One team researched the post-WWII period in Chicago’s Bronzeville neighbourhood. Their narrative explored struggles for work, housing, and surviving economic realities in a segregated northern city during the Great Migration. The team created an audio collage, mixing historical audio excerpts from public archives, such as radio coverage of WWII and 1940s jazz, with newly recorded sounds of the city: the elevated train, automobile traffic, and people on the street.

2.2.2 Sample Historical Speculative Design: *BLAC PPL Handkerchiefs*

The team identified handkerchiefs as significant artefacts for the coughing fits that come with tuberculosis. They used the Speculative Design workshop to expand their narrative of their protagonist’s struggle for survival and sufficiency. Initially, he steals a box of handkerchiefs off a delivery truck and sells them on the street. He uses the money he makes off the stolen goods to fund his own business. He begins producing handkerchiefs that are designed, printed, and sold within Bronzeville—known as the “Black Metropolis.” The company is called “BLAC PPL,” and the handkerchief designs blend popular motifs of 1940’s fashion with subtle and hidden symbols (“dog whistles”) distinctly legible to African Americans in the neighbourhood: a sign that these accessories were specifically *for* people of colour. The

adolescents created a small selection of handkerchief designs, including some intended for non-binary gender identities. The fictional handkerchief business, with its strategy to hire local artists and designers, produced discussion on what it means to consider how individuals focusing on the social impacts of a local economy might work to generate employment, build solidary, and create new catalysts and representations for social identity. In this way, the prototyped artefacts propagated deeper investigation into systemic challenges and opportunities, including their contingencies and opened new space for productive discourse on social identities.

2.3 Public Futures: Year 2 Curriculum

The second year of the Transmedia Collage curriculum was focused on the future. In the first week, the participating adolescents viewed, read, and engaged in critical discussion on select works of science fiction—particularly those conveying themes of discrimination, segregation, and infrastructural inequities.

References from Afrofuturism also provided inputs for this phase. Ytasha Womack, author of the eponymous book, defines Afrofuturism as “an intersection of imagination, technology, the future, and liberation” (Womack 2013, p. 9). Afrofuturist creative works produce cultural, aesthetic, political, and philosophical perspectives on the intersections of the diaspora of African people with science, technology, and science fiction. These works move fluidly between music, film, literature, fashion, art, and design. Reviewing a 2015 panel discussion titled “Afrofuturism: Imagining the Future of Black Identity,” Steven Thrasher summarized: “Racism can give black Americans the impression that in the past we were only slaves who did not rebel; that in the present, we are a passive people beaten by police who cannot fight back; and that in the future, we simply do not exist” (Thrasher 2015). Afrofuturism provides a vehicle for liberating narratives that promote ways of being distinct from Euro-centric narratives of technology and domination. “Afrofuturism allows black people to see our lives more fully than the present allows–emotionally, technologically, temporally and politically” (Thrasher 2015).

The participating adolescents were already enthused by the recent release of the film *Black Panther* (2018); portions of the film were screened and discussed. Students also engaged and discussed works by Sun Ra (active in Chicago in the 1940s and 50s), George Clinton, Shabazz Palaces, Janelle Monae, Wanuri Kahiu, Kerry James Marshall, Cyrus Kabiru, Manzel Bowman, and Tahir Carl Kamali, among others. Exploring Afrofuturist ideas and projects furthered the project’s “decolonizing” of Speculative Design practices by explicitly addressing systemic power dynamics at global and local scales (Ansari, et al 2016).

2.4 Participatory Speculation: Year 2 Speculative Design Workshop

In the second week of the Year 2 curriculum, adolescents engaged in a 3-day workshop on Speculative Design that drew on methods from multiple sources. The process was facilitated visually: each activity was guided by a series of worksheets, called “Machines,” with visual inputs and outputs. These exercises were mediated by designers, historians, and media scholars teaching the curriculum.

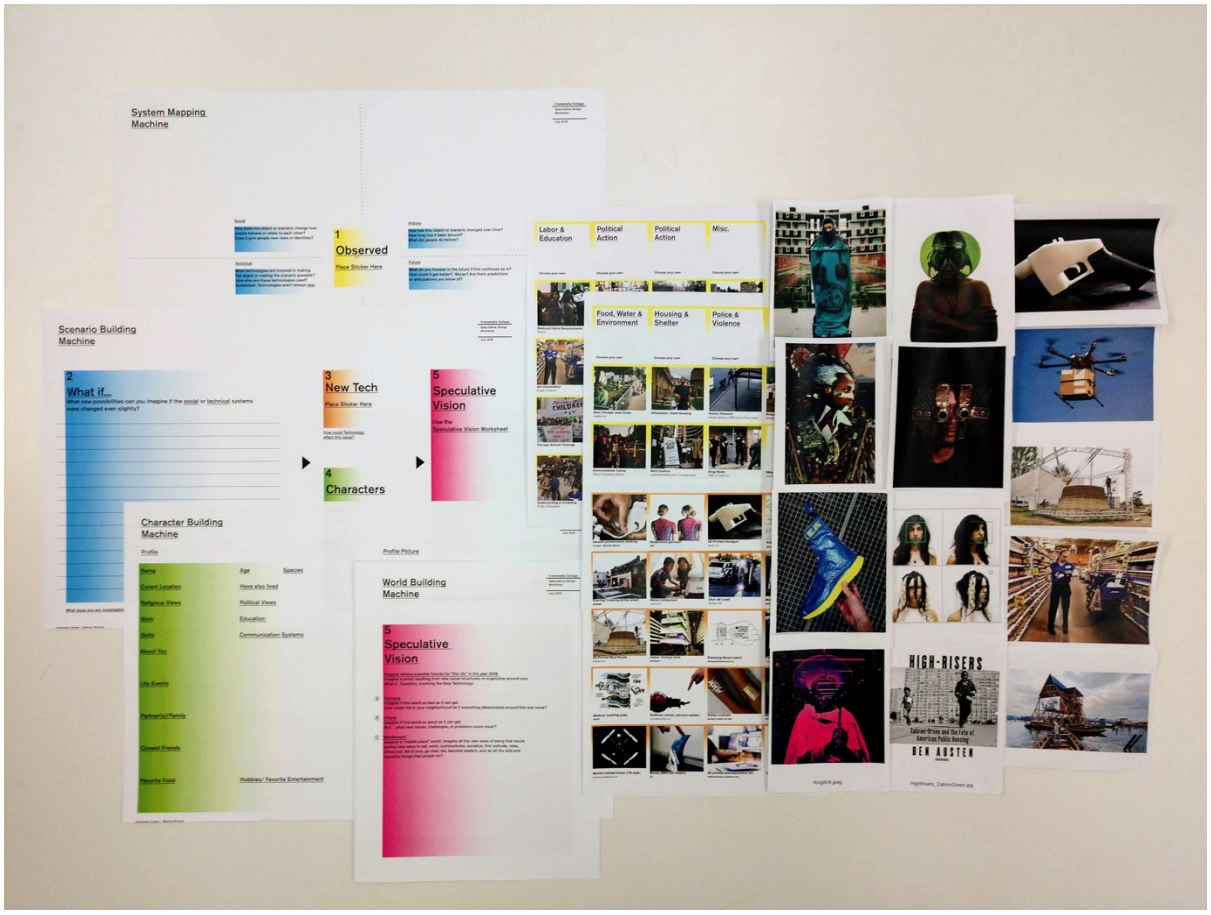

Figure 1. Complete set of Worksheets ("Machines"), Observation stickers, and inputs for Year 2 Speculative Design Workshop.

2.4.1 Observation

Images were sourced in response to local social challenges and political activism that the young people studied in their first week. These images became representative of problems that were identified by, immediately observable to, and directly impacted the participating adolescents. The images were organized within themes. For example, "Food, Water, & Environment" contained images relevant to a lead toxin crisis at Gosch Elementry School in East Chicago, urban agriculture efforts, and infrastructural racism more broadly. The "Police & Violence" category contained images relevant to recent cases of police violence against young men of colour (for example, Ismael Jamison), the practice of "Drug Raids," in which militarized police make unannounced entries into private homes in search of drugs or weapons, and new tactics in the surveillance apparatus of law enforcement such as Microsoft's B1 predictive analytics system (piloted by the Chicago Police Department).

Figure 2. "System Mapping Machine" Worksheet.

2.4.2 System Mapping Machine

Each team selected an observed or observable phenomena and subjected it to a system mapping exercise through the method-as-worksheet *System-Mapping Machine*.[4] In this exercise, the observed phenomenon is mapped to broader social and technical systems, asking the young people to consider two things: 1) this phenomenon is shaped, in part, by larger systems, and 2) because of that, this phenomenon is also contingent on those systems, making it open to transformation, alteration, or redirection through modification of those systems. Next, the young people posed a "What if…" question that imagined a modification of the involved systems, a question intended to inform future-oriented scenarios.

[4] This exercise is akin to "the Implosion Project" as described by cultural anthropologist Joseph Dumit (Dumit 2014).

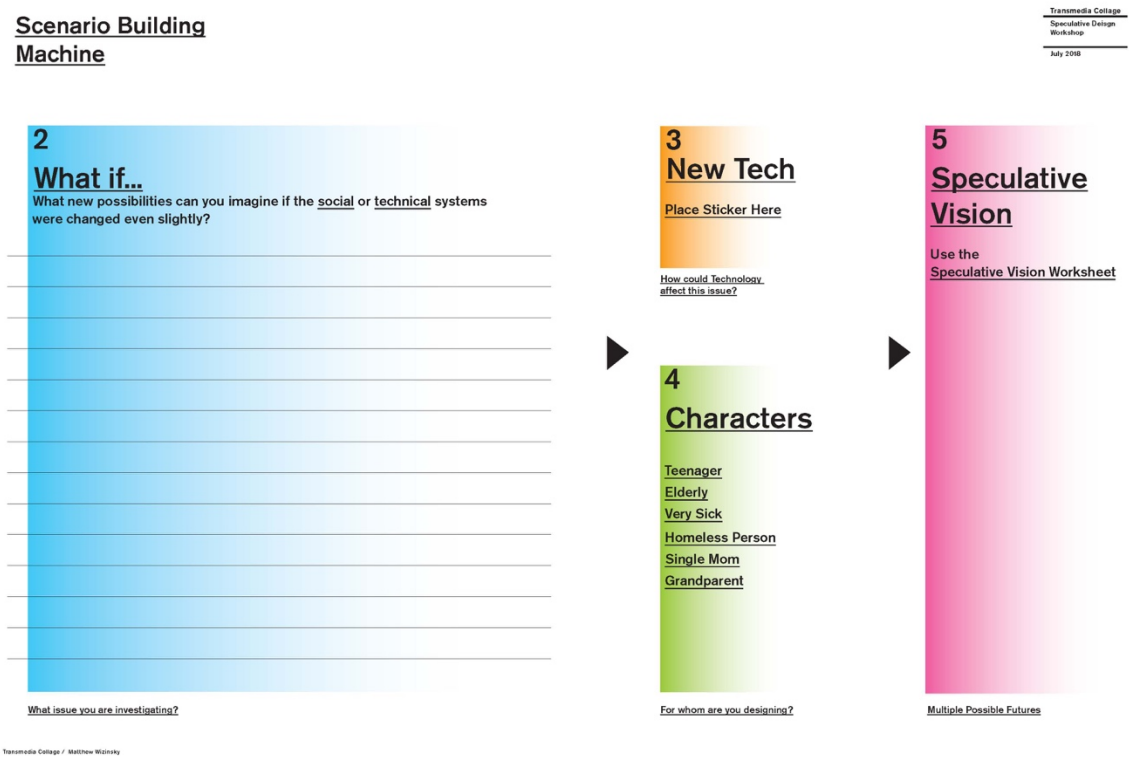

Figure 3. "Scenario Building Machine" Worksheet.

2.4.3 Scenario Building Machine

Next, the *Scenario Building Machine* was used to construct Scenarios. This model adopts aspects of the Scenario method as described by Martin & Hannington (2012) and the Foresight Scenario described by Kumar (2012). It begins by twice filtering the "What if…?" question from the System Mapping. First, it is paired with a new or emerging technology to stimulate thinking about how potential systemic shifts might be impacted by that technology. Second, the Question plus Technology are filtered through a number of possible Characters, to imagine how systemic changes would impact different people differently. Finally, an iterative narrative process constructs three related scenarios—called "Speculative Visions" and distinguished as *Dystopia*, *Utopia*, and *Middletopia* in the *World Building Machine*—to be juxtaposed, comparing and eventually blending different components of the Scenarios. The function of *Middletopia* is to produce a space for negotiation between the positive potentials and negative risks of the general contours of the Scenario. Here, trade-offs such as the social/cultural costs of new opportunities are negotiated. For example, a greater level of control of local democratic functions will require greater levels of engagement and time commitment from citizens. What does this mean for everyday life in the neighbourhood?

Figure 4. "Character Building Machine" Worksheet.

2.4.4 Character Building Machine

Based on the Persona method,[5] the *Character Building Machine* prompted participants to articulate a fictional future resident of Chicago's South Side. The method-as-worksheet prompts participants first to complete a profile akin to those found on social media or other online platforms—bringing a familiar set of identity-making prompts to an otherwise unfamiliar technique. A few odd prompts (such as "Species") remind that this is distinct from a here-and-now profile system. The worksheet asks for a "Profile Picture" which prompted participants to visualize their protagonists. This began a process of moving beyond textual description to stimulate thinking about sensory rich contexts, using design visualization and prototyping "to share a vision" (Hines & Zindato 2016).

2.4.5 Experience Map

To synthesize all of the generative *Machines* in this methodology, participants were given an *Experience Map* framework (Martin & Hannington 2012) to situate their character-protagonists into the contexts of everyday life within the evolving near-future scenario. The model of "A Day in the Life…" served as the temporal axis common to experience maps while the context axis prompted participants to consider details of their characters' goals/challenges and the environments in which they sought to achieve those goals or face those challenges. Variations of this method are, no doubt, familiar to just about any design practitioner or design researcher. Application of this method through the worksheet demonstrated again its efficacy for producing detail-rich descriptions of physical and metaphysical environments for the purpose of constructing detailed scenarios and identifying design opportunities.

[5] "Personas consolidate archetypical descriptions… to humanize design focus, test scenarios, and aid design communication" (Martin & Hannington 2012, p. 132)

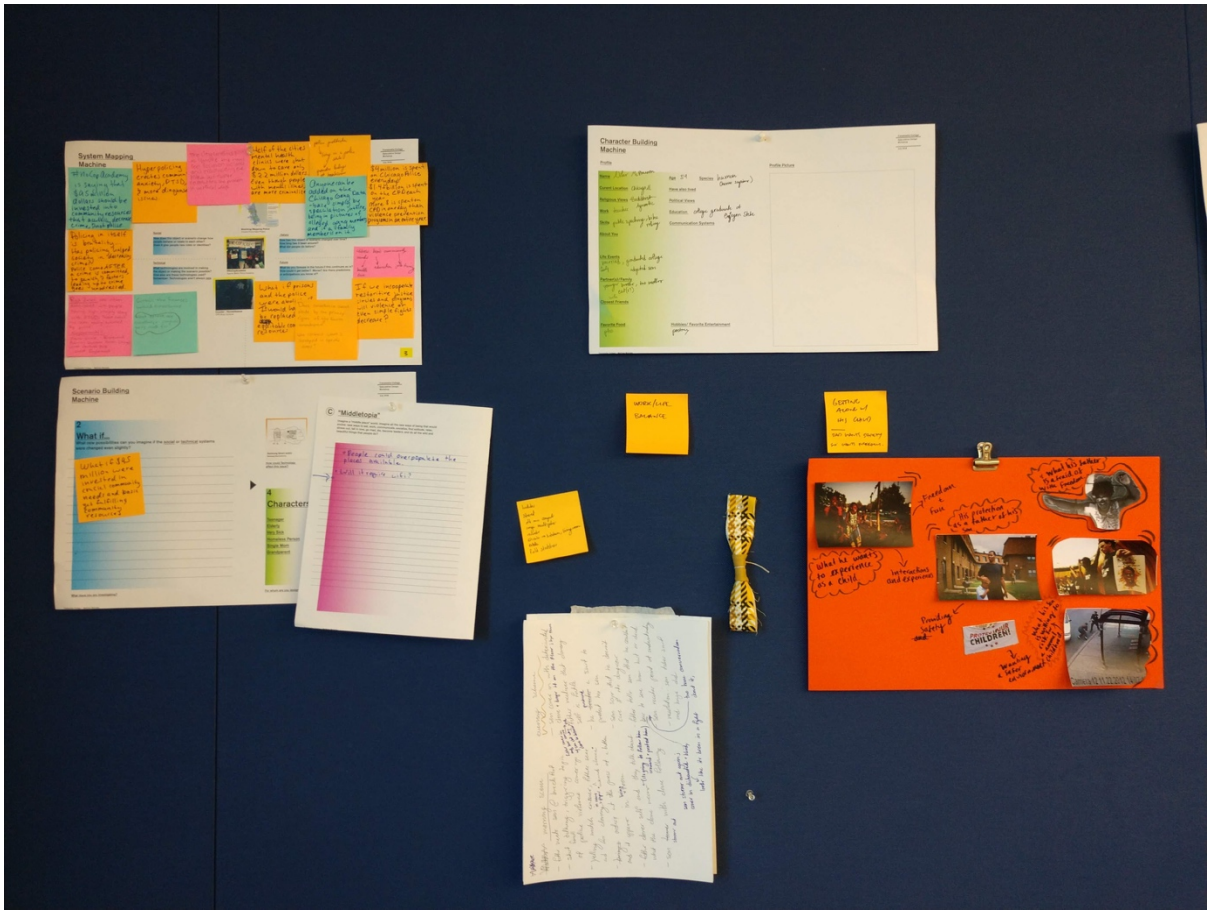

Figure 5. Worksheets ("Machines") completed by adolescents in the Year 2 Speculative Design Workshop.

3 Results: South Side Speculations

The results from the Speculative Design workshop took the form of Scenarios, Characters (personae), and low-fidelity prototypes produced by the adolescent participants. In the final week of the Year 2 curriculum, the participating adolescents worked with media scholars, filmmakers, and staff in the theatre department at the University of Chicago to translate their scenarios into short films. Their characters and prototypes informed script-writing, and they engaged in workshops on storyboarding, acting, shooting, directing, and editing. These short films were generally conceived as advertisements for their speculative objects as a means to depict the future scenarios.

At the conclusion of the curriculum, graduate students in Media Studies from the University of Chicago worked through a further editing and production process to finalize the films. Meanwhile, graduate students in Design and Architecture from the University of Illinois at Chicago used digital fabrication techniques to translate the low-fidelity prototypes the adolescents quickly produced in the workshop into refined models and artefacts. Every attempt was made to maintain the participants' intentions as their video work and prototypes were translated into professional quality media.

Participants worked in small groups, producing five projects within three themes.

3.1 Health & Wellness

In Chicago, community resources have become substantially more unequal in the last 75 years. The South Side has the city's highest rates of school dropout, obesity, commuting times, drug arrests, and incarceration. Across neighbourhoods—from Woodlawn to Englewood—young people have been among the most heavily impacted.

Figure 6. Still from the short film Community Healing Pair, Chicago, 2038, *by Asha Edwards and David Bonsu, 2018.*

Community Healing Pair, Chicago, 2038 (Asha Edwards and David Bonsu, 2018) is a wearable communication system, comprised of a pair of glasses and wristband. Users can access diverse perspectives of the neighbourhood through augmented reality and make use of local communicative functions. The proposed system imagines the capacity for AR to alternate users' views between positive and negative realities of life on the South Side—reminding residents of their neighbourhood's rich past and present of community activism while summoning support from each other to confront ongoing struggles with state violence enacted by the police. The glasses allow users to tap into AR experiences to see the rich history of struggles for equality and liberation in historically significant locations across the South Side or to find out about current community-building and activist events. If the user should come across an instance of police violence, the "restorative circle meeting button" can quickly summon a restorative justice meeting, drawing community members to discuss the event or connect with local harm reduction resources. The project merges historical and contemporary research on local activism with the participating adolescents' personal experiences. As the team described, the negative implications of life on the South Side can sometimes feel utterly overwhelming, while, at other times, they feel the strength to act toward transforming their communities.

3.2 Infrastructure

Infrastructure includes the foundations and facilities needed to sustain everyday life. These include buildings, roads, railways, and energy supplies. Historically, and at present, the South Side has suffered from inadequate infrastructure that includes racially segregated

housing, health care deserts, and limited transportation options. Numerous political and social roadblocks keep material inequalities in place.

Figure 7. Still from the short film Home Pods, Chicago, 2038,
by Carlson Ayanlaja, Daniel Barrera, Yousef Lagundoye, and Symone Pettis, 2018

Home Pods, Chicago, 2038 (Carlson Ayanlaja, Daniel Barrera, Yousef Lagundoye, and Symone Pettis, 2018) imagines a mobile, modular architectural response to the chronic problems of shortages of quality housing on the South Side. Two structural archetypes are blended to create a hybrid home type—including shared community amenities—that can also be moved (by drones) between the South Side neighbourhood of Chatham and the North Side neighbourhood of Albany Park. This project radically reimagines the stark differences in Chicago's segregated neighbourhoods through their building types: the one family bungalow common to the North side and the six flat apartment block common to the South Side. This proposal is narrated through the story of a young entrepreneur who takes on the housing challenge through modular infrastructural innovations, not unlike those from the early twentieth century history of Chicago.

3.3 Policing

The police pervade South Side neighbourhoods, residents' school commutes, and family life. Most of the young people who worked on this project—all African-American and/or Hispanic—have experienced some form of police surveillance in their short lifetimes. Conversations about the contemporary cases of police violence in their neighbourhoods prompted visions of what life without constant police presence might look and feel like. Conversely, new strategies for mitigating the harms of police violence were explored. Students were inspired by Afrofuturist short films, including Wanuri Kahiu's *Pumzi* and Janelle Monae's *Dirty Computer*.

Figure 8. Still from the short film, Cloning Masks and Protective Masks, Chicago, 2038, *by Lauren Johnson, Shurri Peterson, Nia Nobles-Vincent, 2018.*

Cloning Masks and Protective Masks, Chicago, 2038 (Lauren Johnson, Shurri Peterson, Nia Nobles-Vincent, 2018) animated the issue of police violence through the narrative of an inventor trying desperately to keep his son safe from police confrontations. The underlying narrative illustrates real life experiences shared by participating adolescents. Police violence creates intergenerational tensions when parents are desperate to keep their children out of harm's way, but the young people are eager to fight for justice. In the team's fictional version of this narrative, the father and son are in an argument, and the father invents a cloning machine in an attempt to be with his son at all times; however, the machine fails. He creates a mask that serves as a camera-mounted protective helmet so he can keep visual connection with his son's daily activities, but the son refuses to wear it. The father responds, "It's for your own good," and later that same day, the son comes home bloodied from a violent interaction with police.

4 Discussion: Exhibitions as Sites of Public Discourse

The two-year curriculum yielded a variety of material results: historical collages, fictional-historical design objects, future speculative artefacts, and short films. These were publicly presented at multiple venues on Chicago's South Side in early 2019, in the exhibition "South Side Speculations." One criticism of Speculative Design is that it tends to produce discourse only in the rarefied spaces of galleries and exhibition spaces. However, the limited impact or rarefied nature of exhibiting community creative works is here challenged. This project deliberately conceived of its resulting exhibitions as opportunities to activate public space by producing new sites for discourse on topics that were richly and imaginatively investigated by local adolescents. This included the programming of events, workshops, and panel discussions that drew together South Side residents of specific communities—each creating new opportunities to discuss the issues under consideration, including the merits of the resulting future speculations. The participating adolescents thus transformed into public speakers, docents, and topical experts. Beyond a general public audience, these events

were attended by and generated participation from local high school students (the adolescents' peers), parents and family members, and elders who participated in the oral history component. In this way, the exhibitions and their programs generated intergenerational discourse stimulated by the creative, critical work of local adolescents who participated in the summer education program.

5 Conclusion: Prefigurative Design and Media-Making

Transmedia Collage offered a two-summer, interdisciplinary educational experience for twenty-three adolescents in a city that has closed over 200 public schools since 2002 (Lutton, et al 2018). The curriculum blended methods from History, Literary and Media Studies, and Design to facilitate the production of new public historical narratives plus proposals for healthier future neighbourhoods. In the absence of known precedents for pedagogical models that engage adolescents in an integrated curriculum of highly-localised public history and urban futures speculation, the collaborating investigators organized a curriculum that synthesized pedagogical methods from their respective disciplines.

The project demonstrates one small step toward what has been recently coined "prefigurative design": design work that "prompts practitioners and researchers to both imagine alternative futures and to structure design processes to manifest them in the present" (Asad 2018, p. 98). Future work would benefit this effort by developing methods for generating more robust processes and skills toward manifesting these futures within everyday life—by and for the participants. Beyond the creative results locally exhibited and discussed, participating adolescents gained significant trans-disciplinary skills in locally-informed and politically-motivated research and critical, creative practices. This included new skills in producing inter-generational oral histories, archival research, various design processes, producing multi-media narratives, rapid prototyping of objects, and writing, shooting, editing, and producing digital videos. By centring young people of colour in critical, creative practices of visioning the future, their perspectives on issues of race, agency, identity, well-being, and social desires are cast in relief to join the contemporary discourse on urban futures.

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The Digitization of Cordillera Weaving: Designing a New Oral Tradition

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This paper is a review of a 2019 British Council & Crafts Council / Crafting Futures project to support Creating a Sustainable Textile Future for Women via the Digitization of Cordillera Weaving Tradition (CSTFW). The CSTFW project has developed a Learning Tool Kit and Design Tools to support the preservation of a weaving tradition which forms part of the cultural heritage of indigenous communities who live in the mountainous Cordillera region of the northern Philippines. The Crafting Futures scheme supports projects which address "a sustainable future for craft around the globe". It has been identified that while Cordilleran weaving has the status of National Heritage within the Philippines, the numbers of community weavers able to practice is dwindling. The Cordillera Textiles Project *CordiTex* led by Professor Analyn Salvador-Amores from University of Philippines, Baguio, which is proposing to digitise Cordillera Weave Tradition to ensure its sustainability, study and preservation. This paper will present findings from the CSTFW project, which raise the voice of oral craft traditions and explore the opportunities digital tools and methods may play in sustaining a future for global craft practice. What the oral tradition holds on to is the un-common nuances of textile language manifested in work which is crafted and made rather than designed. If the weaving tradition of the Cordillera is to endure and deal with the problems it faces, what type of support will the shift from of an oral to a digital tradition require? This paper aims to consider this concern via a discussion of project-based research evidence and reflection.

Keywords: Crafting Futures; Voices; Oral Tradition; Digitization; Weaving

1 Introduction

In the Cordillera region in the north of the Philippines, there is a rich tradition of weaving that is cultural, functional, and which represents the artistry of the numerous ethnolinguistic groups living in the region. Weaving knowledge within the Cordillera is not held in a written form but is passed on via an oral tradition where the master teachers of weaving are now elderly women. The impact of the oral tradition as an unwritten knowledge base for Cordillera weaving, is now in a critical state and the weaving tradition may become extinct.

> *"The focus of the CordiTex research was conducted among the Tinguian of Abra in northern Luzon, who had scarce documentation of its weaving tradition, but revealed the most intricate designs based on the collections from the museums in the US. The weaving declined in the 1980s, and only one Tinguian community in Manabo, Abra is still weaving, and natural dyeing is revived in Penarubia, Abra. Most of the master weavers are*

elders and many who passed away without transmitting knowledge to the younger generation" (Salvador-Amores 2018)

While the CordiTex project's rationale is to preserve Cordillera Weaving Tradition via the digitization of the weaving patterns, this raised an opportunity to investigate the diminishing numbers of younger weavers working in this tradition. There was an opportunity to evidence the human impact the loss of this weaving tradition will create in the lives of both the women weavers and the population of this area. The CSTFW project forms a bridge between the CordiTex project and the British Council Crafting Futures aim and rationale. The CSTFW project wanted to work with weaving groups from the Cordillera to investigate the loss of cultural weave heritage within the region and to ask how such craft practices, if preserved via the digitization process, can support the livelihoods of women.

The groups of weavers from the Cordillera are identified by their ethnolinguistic languages and represent cultures which use their language to represent identities specific to place, ritual, belief, work, culture. The CSTFW project is focussed on the objectifications and agents of identity which are woven into the objects and textiles the Cordilleran communities make and use.

'Identity is a concept that figuratively combines the intimate or personal world with the collective space of cultural forms and social relations' (Holland, Skinner, Lachicotte & Cain 1998:5)

Weavers from the Ifugao, Ga'dang, Kankanaey, Ibaloy, Ilocos and Tinguian groups and weavers from Bontoc, Abra, Manabo and Mindoro areas were selected to participate in the project. The uptake of weaving amongst younger women in these communities, is diminishing. The development of a digital rationale as a methodology for preservation is explored within this paper and in addition to the initial remit of the Crafting Futures project, Kelly and Stephens began to develop research questions which ask what impact the digitisation process will have upon the voices and identities of the Cordillera.

2 Research Methodology

Part 1: Study of the traditional weave samples within the Museum Kordillera, Baguio; The National Museum of Philippines in Manila and National Museum of Vigan in Ilocos Sur.

The collections viewed are significant in their rarity in anthropological terms and include examples of weaving tools, back strap and foot looms, ritual artefacts and historical ethnographic photography. A second purpose for the museum visits was to examine Cordillera Textiles first hand to explore the weave structures via a process of draft notation or weave drafting.

"draft notation uses graph paper as a framework. The space between its evenly spaced verticals is understood to indicate the warp threads, that between the horizontals, spaced similarly and intersecting at right angles, the filling threads. The little squares thus formed denote the intersection of warp and weft… of course more than the thread construction has to be identified in the analysis of a cloth…when these facts have been established, all the information required for the reproduction of a cloth has been ascertained, for the procedure of weaving is merely a matter of inference" (Albers, 2017: 22)

Part 2: Field visits to five Cordilleran weaving communities in Kiangen, Abra, Manabo, Santiago and Mindoro.

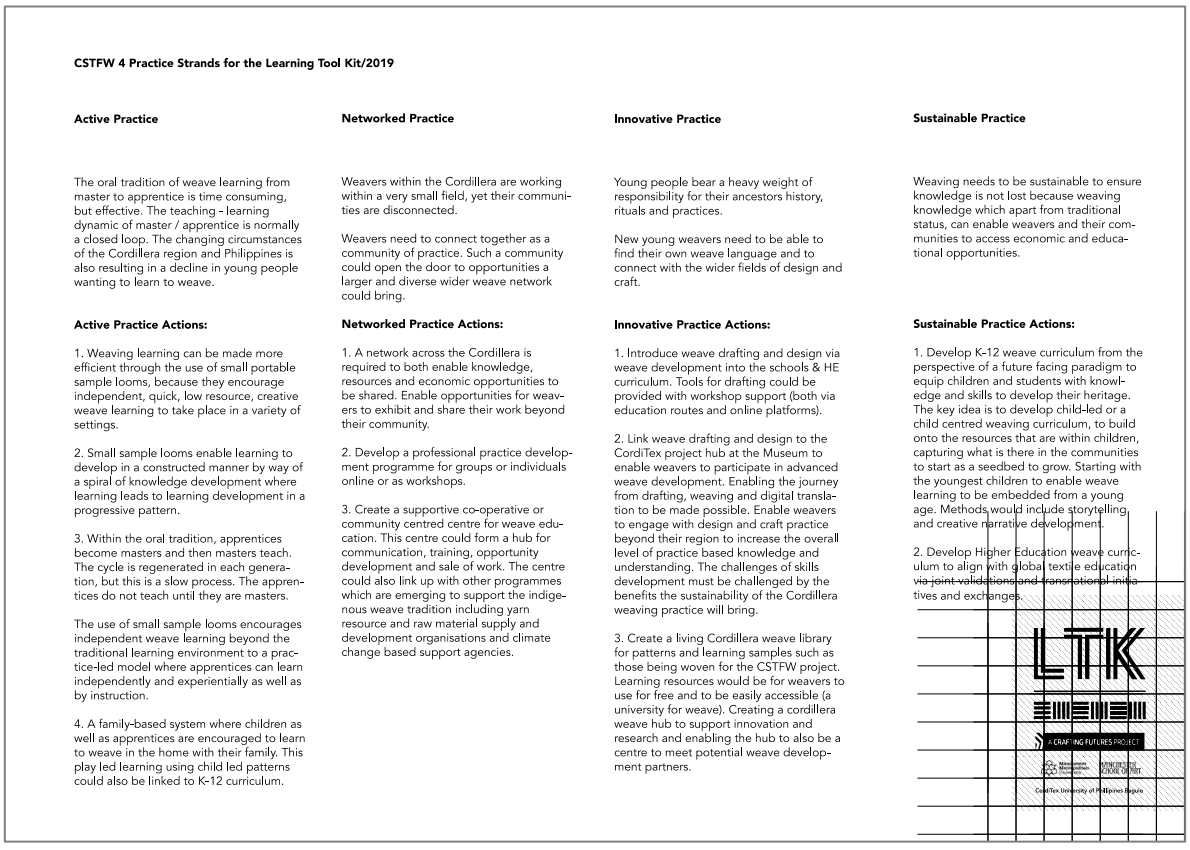
The aim of the field visits was to undertake field research to gain an understanding of the research problem which investigates if there is 'the potential of craft to improve the livelihoods of women' (British Council, 2018). Qualitative research activities to capture evidence and data for the project, included community, field and weaving practice observations, ethnographic interviews and documentation by film, sound, and photography. The visits also gave the project partners the opportunity to introduce the CordiTex and CSTFW project to the weavers and their communities.

Part 3: A Learning Tool Kit Development Workshop held at The University of Philippines in Baguio.

A *Learning Tool Kit* workshop was delivered to key stakeholders from the communities. The workshop was organised with support from the University of Philippines in Baguio and the CordiTex team and Cordilleran weavers travelled from remote and diverse locations across the region to attend. The workshop included a *Design Thinking* (Cross, 2011) workshop, a weave drafting workshop and a collaborative reflective plenary. Stephens remarked that she had never had such a positive response to her weave drafting workshop in previous teaching experiences.

Part 4: Dissemination of Learning Tool Kits to weavers and stakeholders in The Philippines.

A *Learning Tool Kit* framework was developed by Kelly & Stephens and included the provision of 10 small loom kits for apprentices.



CSTFW 4 Practice Strands for the Learning Tool Kit/2019

Active Practice

The oral tradition of weave learning from master to apprentice is time consuming, but effective. The teaching - learning dynamic of master / apprentice is normally a closed loop. The changing circumstances of the Cordillera region and Philippines is also resulting in a decline in young people wanting to learn to weave.

Active Practice Actions:

1. Weaving learning can be made more efficient through the use of small portable sample looms, because they encourage independent, quick, low resource, creative weave learning to take place in a variety of settings.

2. Small sample looms enable learning to develop in a constructed manner by way of a spiral of knowledge development where learning leads to learning development in a progressive pattern.

3. Within the oral tradition, apprentices become masters and then masters teach. The cycle is regenerated in each generation, but this is a slow process. The apprentices do not teach until they are masters.

The use of small sample looms encourages independent weave learning beyond the traditional learning environment to a practice-led model where apprentices can learn independently and experientially as well as by instruction.

4. A family-based system where children as well as apprentices are encouraged to learn to weave in the home with their family. This play led learning using child led patterns could also be linked to K-12 curriculum.

Networked Practice

Weavers within the Cordillera are working within a very small field, yet their communities are disconnected.

Weavers need to connect together as a community of practice. Such a community could open the door to opportunities a larger and diverse wider weave network could bring.

Networked Practice Actions:

1. A network across the Cordillera is required to both enable knowledge, resources and economic opportunities to be shared. Enable opportunities for weavers to exhibit and share their work beyond their community.

2. Develop a professional practice development programme for groups or individuals online or as workshops.

3. Create a supportive co-operative or community centred centre for weave education. This centre could form a hub for communication, training, opportunity development and sale of work. The centre could also link up with other programmes which are emerging to support the indigenous weave tradition including yarn resource and raw material supply and development organisations and climate change based support agencies.

Innovative Practice

Young people bear a heavy weight of responsibility for their ancestors history, rituals and practices.

New young weavers need to be able to find their own weave language and to connect with the wider fields of design and craft.

Innovative Practice Actions:

1. Introduce weave drafting and design via weave development into the schools & HE curriculum. Tools for drafting could be provided with workshop support (both via education routes and online platforms).

2. Link weave drafting and design to the CordiTex project hub at the Museum to enable weavers to participate in advanced weave development. Enabling the journey from drafting, weaving and digital translation to be made possible. Enable weavers to engage with design and craft practice beyond their region to increase the overall level of practice based knowledge and understanding. The challenges of skills development must be challenged by the benefits the sustainability of the Cordillera weaving practice will bring.

3. Create a living Cordillera weave library for patterns and learning samples such as those being woven for the CSTFW project. Learning resources would be for weavers to use for free and to be easily accessible (a university for weave). Creating a cordillera weave hub to support innovation and research and enabling the hub to also be a centre to meet potential weave development partners.

Sustainable Practice

Weaving needs to be sustainable to ensure knowledge is not lost because weaving knowledge which apart from traditional status, can enable weavers and their communities to access economic and educational opportunities.

Sustainable Practice Actions:

1. Develop K-12 weave curriculum from the perspective of a future facing paradigm to equip children and students with knowledge and skills to develop their heritage. The key idea is to develop child-led or a child centred weaving curriculum, to build onto the resources that are within children, capturing what is there in the communities to start as a seedbed to grow. Starting with the youngest children to enable weave learning to be embedded from a young age. Methods would include storytelling, and creative narrative development.

2. Develop Higher Education weave curriculum to align with global textile education via joint validations and transnational initiatives and exchanges.

LTK

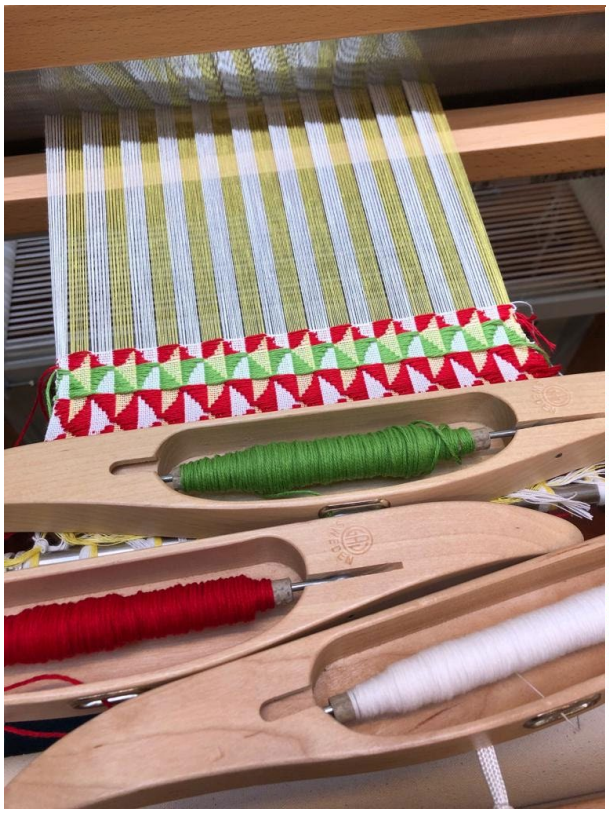
A CRAFTING FUTURES PROJECT

CordiTex University of Philippines Baguio

Figure 1: CSTFW 4 Practice Strands for Learning Tool Kit 2019. Image copyright: R Kelly

Part 5: The Digital translation of Cordilleran Patterns via TC2 Digital Loom.

The digitization of a selection of woven samples from the Museum Kordilyera archive will be translated by Michelle Stephens. Woven fabrics produced from archive samples will be used to inform the *Learning Tool Kit* and the development of digital weave expertise within the University of Philippines. The new digitally produced textiles will then be exhibited at the Museo Kordilyera, Baguio and added to the museum's teaching collection.



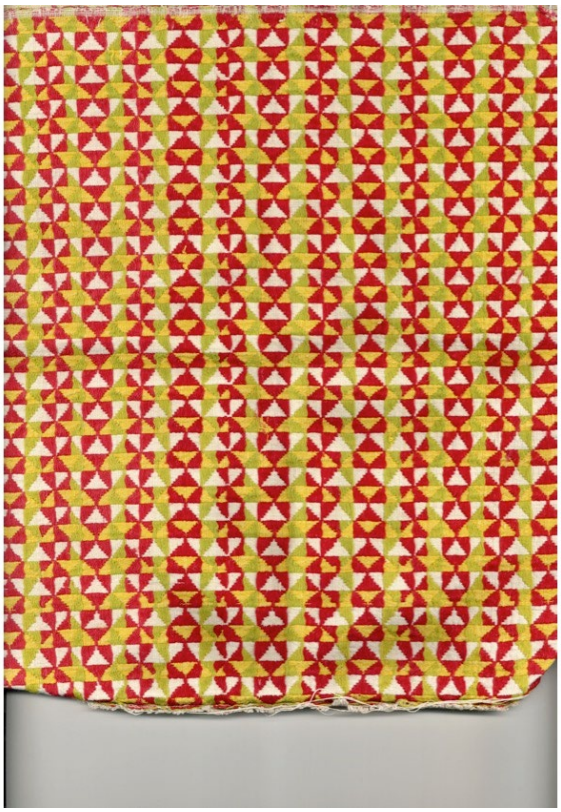


Figure 2: July 2019 weaving translation by Stephens; Figure 3: Dinapat Lime woven textile date unknown. Image copyright: CordiTex

The five parts of work for the project comprised a suite of contexts within which new knowledge could develop and where new research data could be collected. Decisions on how best to plan the project were made based upon factors including;

- The need to pre-plan at a distance from the Philippines prior to field visit;
- The short timeframe for the field visit (8 days);
- The urgent need to document of the oral weaving tradition and examples of weaving practices from the communities.

The project research methodology was informed by a range of theoretical perspectives to ensure that the voices of the Cordilleran weavers and communities could be heard. Therefore, while Kelly and Stephens undertook phenomenological and ethnographic approaches which included observation, participation and Deep Hanging Out (Geertz, 1998), the methods employed on return from the field visit included discourse analysis to enable post-positivist and post-structuralist interpretations to be undertaken to distinguish between the context of the situation and the evidences of culture which were captured (Lee & Poynton, 2000). To move the research from *Understanding* to *Exploration* and *Materialization* A *Design Thinking Cycle* (Cross, 2011) was employed. A Theory of Change

(Nesta, 2018) model was also utilised at different stages and proved a useful framework to help identify the project research questions, aims and outcomes.

Within the *Understanding* phase of the project, the examples which follow, demonstrate research activities which resonate with the question of this paper.

3 Understanding Cycle Activities:

3.1 The study of the traditional weave samples within the Museum Kordillera, Baguio and National Museum of Philippines in Manila.

Prior to January 2019, archive textiles images were sent to the UK project partners to illustrate the breadth and depth of variation in designs of the different Cordillera communities. The textiles had already been documented as part of the CordiTex project and the images provided an insight into the general patterns, cloth construction, patterning and colouring of the different regions. Visits to the Museums and archival collections highlighted the meaning and taboos held within the textiles and via related artefacts, photographs and cultural objects. The woven textiles are used as ceremonial cloths, burial cloths and clothing. The level of denotation of the cloth and/or their motifs was dependent of each ethnolinguistic group's heritage. Initially, to project partners Kelly & Stephens as outsiders, the cultural value placed upon these cloths was overwhelming and difficult comprehend. The Cordillera groups were traditionally "a society made up of small, dispersed, relatively egalitarian and acephalous, rivalrous groups, with an oral rather than written history and a reputation for wildness (e.g. headhunting)" (Rosaldo,1980). Following the field site visits to meet the weavers, the close link between the museum collection and the connection to the communities visited became clear. A remarkable moment came when community weavers were taken into the CordiTex archives to view the work of their ancestors. This moment sits as a Learning Threshold (Meyer and Land, 2003, 2005) crossed, because the weavers were able to learn and reflect upon the voices of their past, present and future within the archive.

Figure 4, 5 & 6: Workshop participants visit the CordiTex project archive at Museum Kordillera, University of Philippines in Baguio. Image Copyright Arnold Salvador-Amores

3.1.1 Understanding the Textiles

In order to undertake a deconstruction of the patterns for the interpretation of designs into digital translation, it was vital for the partners to have first-hand interaction with the textiles to gauge cloth weights and colour. The weave translation process was conducted using the following methods:

- Technical notes
- Thread counts
- Photographic documentation
- Production of woven drafts

What the oral tradition holds on to is the un-common nuances of textile language manifested in work which is crafted and made rather than designed. Drafting however, can be undertaken by any weave specialist (or keen novice) and is a binary language which is also used in coding and other digital processes. It is implied within the oral tradition that the written draft process and resulting visual language creation creates a *boundary object* (Star & Griesemer, 1989) where the main feature of the weaving draft is its global commonality. A concern with regard to interventions into the oral traditional of weaving was raised during the *Learning Tool Kit Workshop* by Mr Marlon Martin from the Ifugao Heritage Weave Centre and also by Adelaida Lim who is the president of the Philippine Habi Textile Fair. The concerns for drafting based interventions and the digitisation process have informed the rationale for this paper, which is in part, scrutinizing a predominantly western research investment into boundary object based methodologies.

The Digitization of textiles is a growth area of Textile Design and conservation with work being undertaken at The Centre for Advanced textiles at Glasgow School of Art (Britt and Shaw, 2014) and by Anna Buruma who led the digitization of the Liberty of London archive (Buruma, 2007). Such examples of organised digitization have been undertaken *a priori* in that the digital translation has been made at a distance in time from the original textile making. The work of the CSTFW and CordiTex project can be done *a posteriori* because the textiles are still, at the point of the writing of this paper, being made, so actual observable practice can be observed, documented and responded to.

The CSTFW project and *Learning Tool Kit* proposes to directly address concerns with regard to the authenticity of the drafting practice going forwards (Adorno, 1973:7). The *Learning Tool Kit* is designed to empower weavers within their own contexts, to author their process of development themselves. With the draft process placed in the weavers' hands, an authenticity under the lens of Adorno (1973) is created. The culture of weaving will be located within its historical process and will thus challenge the unauthentic experiences boundary objects might create if their language is not universal or is maintained by institutional or unwelcome gates (Star & Griesemer, 1989). The spaces and places for the practice of weaving within the digital paradigm must be as flexible as the backstrap looms the Cordillera weavers use, ready to pack up and move or work on the spot when required.

3.2 Field visits (Jan 2019) to weaving communities, workshops and home weavers.

3.2.1 Visit to The Ifugao Indigenous Peoples Education Centre and Community Heritage Galleries in Kiangan.

Described as a Living Museum the heritage galleries feature a weaving workshop where traditional backstrap looms and Ikat warp dyeing methods are practiced. The centre is organized to receive tourist visitors who purchase textiles and observe demonstrations. The Ifugao Indigenous Peoples Education Centre and Community Heritage Galleries are run by Director Mr. Marlon Martin who is also Chief Operations Officer of the Save the Ifugao Terraces Movement (SITMo), which works to preserve the traditional rice terraces of the Cordillera.

Ifugao Society is still organized in a system where the *Kanadangyan* members sit at the top of the community as the most privileged class. Mr. Marlon Martin comes from the *Kanadangyan* class and his sympathetic approach as centre director is supportive of the

underlying traditions of his community where the privileged always share their rice with the *Nawotwot* the landless poor at the bottom of this tribal system (Tolentino, 2018). Martin has a sense of social justice, which despite his position at the top of this society, works hard for the preservation of Ifugao culture and to improve the livelihoods of the local community.

Figure 7: Master Weaver in Ifugao. Image copyright Arnold Salvador-Amores

Our visit to Kiangen and our second meeting with Mr. Marlon Martin at The *Learning Tool Kit Workshop* was informative to our learning and understanding of the societies and tribes of the Cordillera and the origins of the indigenous weaving tradition.

- The Ifugao centre provides a support system for weaving where women work as independent master weavers, choosing their own hours and sell work through the centre, but they are not paid a wage.
- Women work side by side on backstrap looms where they talk and share, learn and teach together in an oral tradition.
- The centre welcomes students and academics to study on site so the ethos of this weaving community is being exported and disseminated.

Martin's reflections shared both in Kiangan and at the *Learning Tool Kit Workshop* are that his community and culture is vulnerable. He identified that their tradition should not be viewed through a lens of history or as a relic of the past, but as a vibrant part of the present and future. Martin maintains the oral tradition as a foundation of his culture where the tensions between the central role of textiles within rituals, birth, feasts and funerals in this community is in conflict with the predominant modern ethos of the mainland Philippines and the wider world. A co-weaver who participated in the *Learning Tool Kit Workshop* reflected 'that cloth can also mean gold to the Ifugao' so any development which supports their community to trade textiles or textile knowledge for her, is very welcome. However, Martin let us know that many of the weavers he is working with live below the poverty line.

3.3 Manabo Weavers Association, Manabo, Abra:

Figure 8: Manabo weavers in their weaving garage. Jan 2019. Image copyright: Arnold Salvador-Amores

The Manabo community has a status and history that places it in a superior position in the hierarchy of weaver communities and culture, due to the complex weaving patterns and fine cotton used. Paradoxically, it is now in the position of being the community most at risk from the weaving tradition disappearing. Manabo is a new village still under construction, mainly consisting of breeze-block houses with foot weaving looms housed in a garage. From what we were told, the village had moved to this new location from their traditional area due to a change to growing tapioca rather than rice.

The women weavers we met were all united in their view as to why weaving was declining in their community, specifically, the lack of interest from young women or men to becoming weavers. The decline in weaving take up means that the end of weaving in the community will come when the older Master Weavers met, die. Our host had arranged to collect a loom belonging to Master Weaver Teresita Obingayan to take back to the Museo Kordilyera due to the lack of space in the garage space and because it was unlikely ever to be used again.

A shift in the dynamic of the visit came when Kelly & Stephens delivered an impromptu weave drafting workshop in a garage space. Stephens introduced the weave drafting process and showed examples of her work to the weavers on her mobile phone. Each weaver became interested in the process and was fascinated in the manner in which they could draft their weaving. During the impromptu workshop, the drafting process became an expression of signature, where each weaver became the author of their draft just as when on the loom they are the writers of their cloth. The weavers saw the potential to adapt or subvert the patterns to enable the expression of different ideas.

There was a sense of despair that the young of the community were either not prepared nor interested in learning to weave. With this group in particular, the potential of weaving as a good source of income could be developed and the *Learning Tool Kit* has been designed with this particular community in mind. The contrast between the lack of space in the garage with the 'packed-in' looms, and the freedom of space the draft process enabled was evident. The workshop ended with the weavers, sitting outside in the fresh air at an outdoor table, with the women continuing to draft their patterns after the project team had left.

Figure 9 & 10: Manabo weavers drafting at an outside table in Jan 2019. Image copyright Arnold Salvador-Amores

3.4 Sabangan Weavers Association and local weavers at home/workshop in, Santiago and Mindoro in Ilocos Sur:

Figure 11: 85-year-old Catalina "Talin" Ablog Weaving a Binakul Cloth at home in Jan 2019. Image copyright R Kelly

A visit was arranged to meet three elderly weavers and an apprentice weaver granddaughter in their homes in Santiago a village near to World Heritage City Vigan in the Illocos Sur area. The weavers were 85-year-old Catalina "Talin" Ablog, 79-year-old Nena "Ibing" Aganon, and 75-year-old Felicitas "Petra" Espejo. In the first home we met master weaver Talin who is working in a home where she had lost sections of her roof in the December 2018 typhoons. There were aspects of high levels of actualizing experience (Maslow, 1943) demonstrated by these weavers in that they work independently, operate a professional business which is able to cost, weigh and measure fabric and they are masters in their craft. The manner in which the weaving has been a central part of their family's communities and the oral tradition, which has enabled the weaving to be passed on, is remarkable.

Concerns for the Sabangan women are their very monetary income. Their wellbeing and identity however, comes from the act or ritual of weaving rather than the income generated. Being a weaver is the identity taken by these women and they demonstrated this via:

- Their independence;
- Their work from home;
- Pride via photographs of work in the home.
- Participation in education projects;
- Family support structure and the connectiveness across generations;
- Direct selling;
- Peace at work – one weaver described her loom as 'her office'.

Figure 12: Apprentice granddaughter weaving on her own loom at home in Jan 2019. Image copyright R Kelly

The Mindoro community visited, demonstrated a highly proficient level weaving work and commercial potential due to quality, range of colours, scales and patterns observed. The weavers work in pairs with one weaver at the back of the loom switching the shafts and the other main weaver works at the front of the loom producing the cloth.

Figure 13: Mindoro weavers working in a pair in Jan 2019. Image copyright M Stephens

The level of tacit knowledge and skill observed in the Mindoro weave workshop is notable in comparison to other site visits. The environment of this workshop was a concern, in particular the proximity to the sea and the visibility of an open drain running through the workshop/home. The team reflected that it seemed to them that the organization and capability of these weavers is not matched by their material circumstances and we questioned ourselves how in such circumstances the digitization of weaving can affect this social situation? Two members of the community took the opportunity to travel with us to attend the *Learning Tool Kit Workshop* in Baguio. The community were obviously very interested in the new methods being introduced. The development of a *Learning Tool Kit* alongside the digitisation process and the research potential such investments bring, is supportive of the development of a weaving network and better links to education and markets. Therefore, the CSTFW and the CordiTex project will create significant impact if linked up effectively with this, the poorest community we visited.

3.5 *Learning Tool Kit Development* Workshop at The University of Philippines in Baguio.

Figure 14: The Learning Tool Kit Workshop at University of Philippines in Baguio held 19th January 2019. Image copyright R Kelly

The *Learning Tool Kit Development* Workshop at The University of Philippines in Baguio was attended by thirty-five participants from the Cordillera, academics and textile stakeholders. The methods used in preparing for the *Learning Tool Kit Development* Workshop reflected a pedagogic process to most effectively meet the project aims and collect the data required. A method for the multi-lingual multi stakeholder workshop was sought which enabled inclusive participation. A Lego® Visualisation method (Lego®, 2015; Blair and Rillo, 2016) met the aims of the workshop because visualisation enables reflection and language to develop through the description of models and objects made. It has been evidenced that objects can be used to visualise concepts and thoughts as they create a reflective space between a person, their thoughts and their discourses (Gauntlett, 2011; Kelly, 2017;).

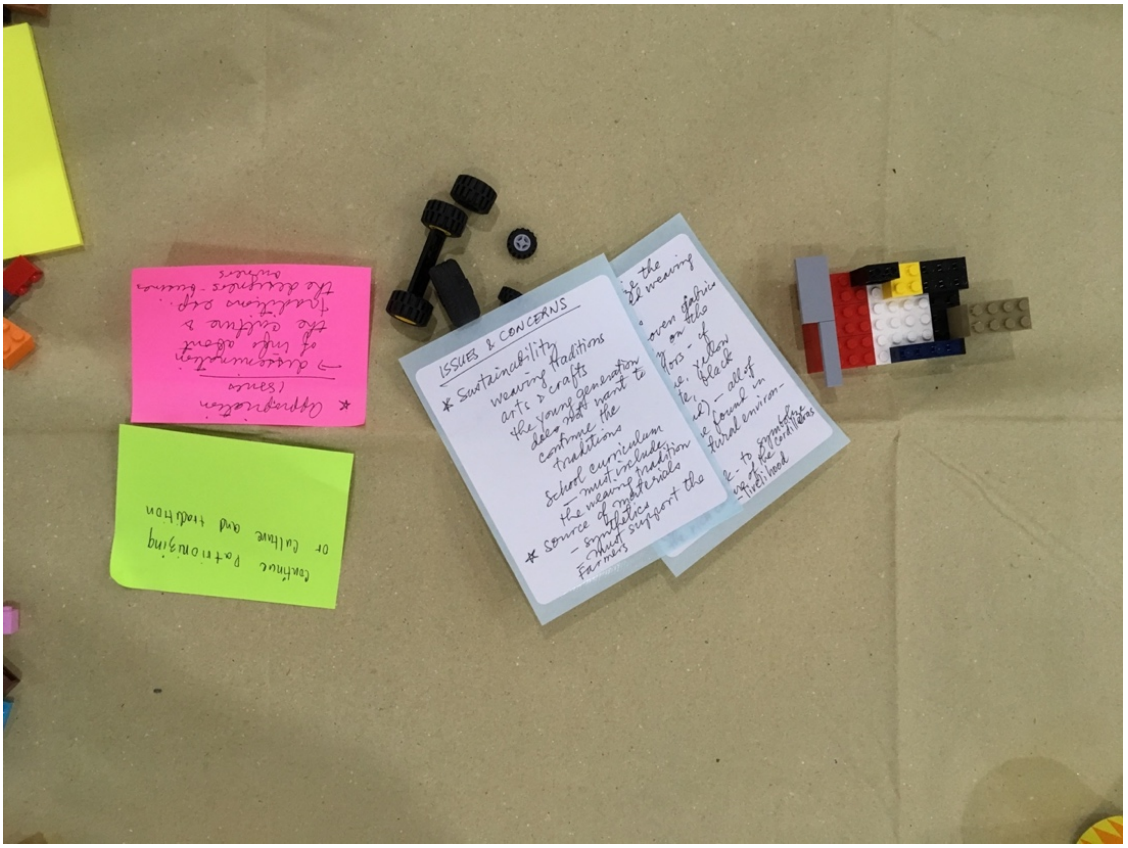


Figure 15: A Lego loom visualisation and reflection on weaver concerns, Jan 2019. Image copyright A Salvador-Amores

> *"significant symbols – words for the most part but also gestures, drawings, musical sounds, mechanical devices… anything that is disengaged from its mere actuality and used to impose meaning upon experience" (Geertz 1973, p45 in Crotty 1998 p53)*

The effects of the Lego® method are that simple questions can be used to generate meaningful qualitative data. The method was chosen to replicate how oral teaching and learning works by supporting the discourse to evolve and for this process to be evidenced as a group experience. A set of simple questions were posed under three headings: Place, Knowledge and Concerns.

"Use the Lego to: Describe a place which is yours… Tell us something only you know about Cordillera Weaving Tradition... What most concerns you about the preservation of Cordillera Weaving Tradition?"

As part of the *Learning Tool Kit Workshop*, participants were also taught to draft their weaving via a deconstruction of the weave structures. This was a first-time learning experience for all participants and they expressed their wonder and surprise via the closing workshop plenary at being taught something useful to their practices. Drafting is a *threshold concept* (Meyer and Land 2003, 2005) that is required to enable digital weaving to take place, because it translates woven cloth into a binary language. By confronting their practices through the Lego® method and by learning the practice of drafting, the weavers reached a new position where new seeds for the understanding of their weaving tradition were sown.

4 *Exploration*/ Initial findings:

- The oral tradition requires someone to receive the learning and teaching accurately and to remember this knowledge at a future date. If there is no listener/relater, then the knowledge ceases to exist.

- The oral tradition is geographically defined (within the examples given) but can be exported to other settings e.g. other communities or learning spaces using digital media/phones has occurred within communities and at the workshop.

- The oral tradition places a burden/responsibility/stewardship on families and communities to maintain and transfer knowledge, when its use both economically and socially may not be to the immediate or future benefit of individuals and communities involved.

- The economic benefits gained via the external preservation of the tradition via digitization, may not be passed back to the community.

- The oral tradition benefits where learning is situated in a particular environment which recognises the social relationship between master and apprentice, or within Cordilleran societies from grandmother to daughter or grandchild. (Lave and Wenger 1991)

- The oral tradition results in the work evolving and being autonomously owned by the community that creates it, giving status to the weavers as stewards of this knowledge.

- The teaching of weave Drafting methods may encourage a sustainable weave learning framework to evolve.

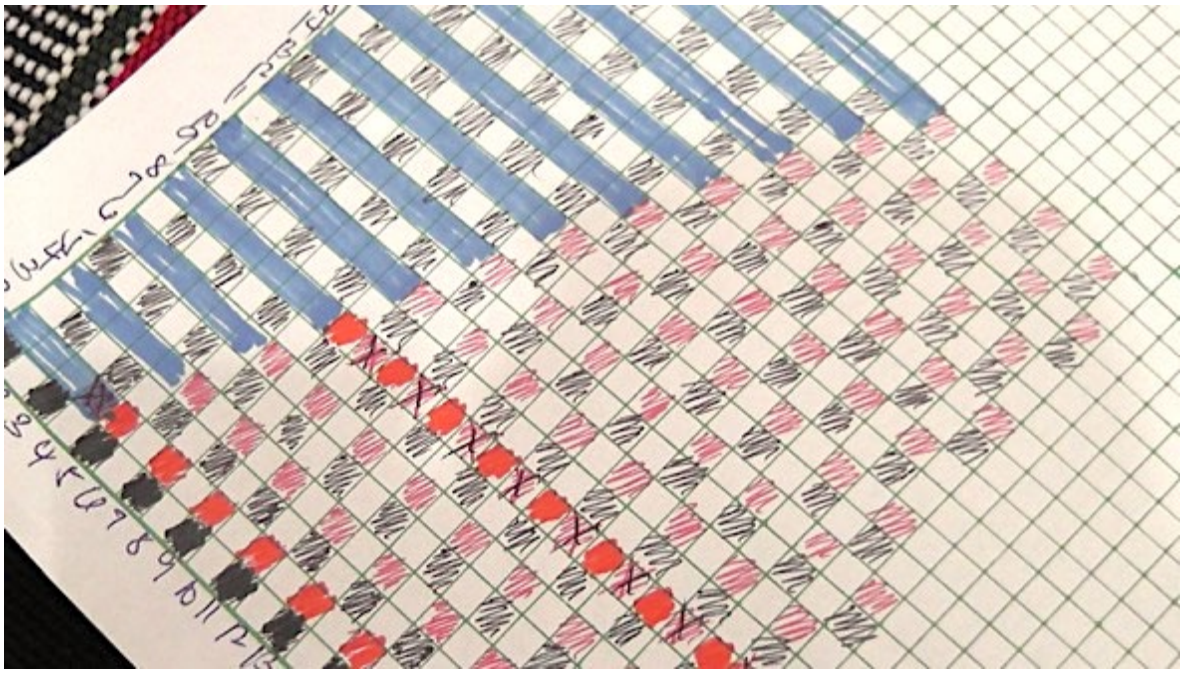


Figure 16: A weave draft created during Learning Tool Kit Workshop, Jan 2019. Image copyright M Stephens

The findings from the CSTFW project have informed the development of a *Learning Tool Kit* which comprises a range of resources which are formed by four practice actions:

Active Practice Actions:

1 Weaving learning can be made more efficient through the use of small portable sample looms, because they encourage **independent, quick, low resource,** creative weave learning to take place in a **variety of settings.**

2 Small sample looms enable learning to develop in a **constructed manner** by way of a spiral of knowledge development where learning leads to learning development, in a progressive pattern.

3 Within the oral tradition the cycle is regenerated in each generation, but this is a slow process. The use of **small sample looms** encourages independent weave learning in a practice-led model where apprentices can learn independently and experientially as well as by instruction.

4 A **family-based system** where children as well as apprentices are encouraged to learn to weave in the home with their family. This play led learning using child led patterns could also be linked to National Philippine K-12 school curriculum.

Sustainable Practice Actions:

1 Develop K-12 weave curriculum from the perspective of a future facing paradigm to **equip children and students with knowledge and skills to develop their heritage**. Develop a child centred weaving curriculum to build onto the resources that are within children and the community as a seedbed to encourage and enable weave learning to be embedded from a young age. Methods would include storytelling and cultural narrative identities development.

2 Develop Higher Education weave curriculum to align with global textile education via **joint validations and transnational initiatives and exchanges**.

Innovative practice actions:

1 Introduce **weave drafting and design** via weave development into the **schools & HE curriculum.** Tools for drafting could be provided with workshop support (both via education routes and online platforms).

2 Create a **living Cordillera weave library**, **research and learning hub** for weavers and academics to use for free and be easily accessible.

3 Link weave drafting and design to the CordiTex project hub to enable weavers to participate in **advanced weave development and research**. Enabling the journey from drafting, weaving and **digital translation** to be made possible and to increase the overall level of practice based knowledge and understanding.

4 Anxiety about the introduction of new practices must be challenged by the benefits the sustainability and rigour, the research processes of the CordiTex project and CSTFW project bring.

Networked Practice Actions:

1 A **network of weavers across the Cordillera** is required to both enable knowledge, resources and economic opportunities to be shared. Enable opportunities for weavers to exhibit and share their work beyond their community.

2 Develop a community of practice for weaving groups or individuals online or via workshops.

3 Create a supportive co-operative community centre for weave education. This centre could form a hub for communication, training, opportunity development and sale of work. The centre could also link up with other programmes which are emerging to support the ethnolinguistic weave traditions including yarn resource and raw material supply, government organisations and climate change based support agencies.

5 Conclusion

The CSTFW project captured the voices of the elderly weavers and their young apprentices; customers; educators and the field of global textile culture which includes the *Crafting Futures* British Council project audience. The weavers are contained by their tradition. What these women are saying is audible only in the echo chamber created by the oral tradition and the systems which support it.

Figure 17: Master weaver speaking during the reflective plenary at the Learning Tool Kit Workshop, Jan 2019. Image copyright: A Salvador-Amores

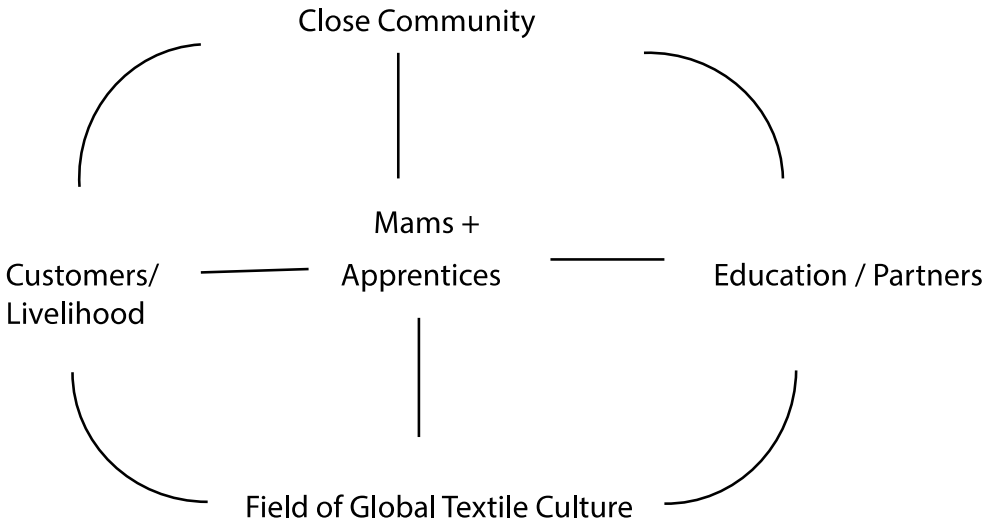


Figure 18: Diagram to illustrate the oral tradition echo chamber. Image copyright R Kelly 2019

The pressure upon the Cordilleran weavers is multi-layered and heteroglossic. They are working to meet the demands of a range of voices. The communities also face the potential demise of their culture and tradition. The weavers therefore were brave in being able to articulate and find a voice within the workshops and visits undertaken for the project and their voices spoke with validity and agency:

> *"Weaving is based in or near the home and that being at home or with their family and community is an important part of the weaving experience….*
>
> *The value of weaving as a source of income is vital now that typhoons are occurring across all seasons, making work in the rice fields less dependable and more dangerous".*

(Reflections taken from the plenary of the Learning Tool Kit Workshop UoP Baguio 2019).

Figure 19: A selection of participants from the Learning Tool Kit Workshop and project team, Jan 2019. Image copyright A Salvador-Amores

What was observed by this project was an ideal of weaving practice which places the women weavers at the centre of their communities and supports the sustainability of ethnolinguistic cultures within the Philippines. The woven cloths of the Cordillera become a language of weaving which enables an eternal conversation to take place between the community ancestors and the current stewards of this unique tradition. The Cordilleran weavers use weaving as a practice to bring meaning and understanding to their world. The oral tradition of teaching between master and apprentice creates a richness this culture and society own, but the process is too slow against the pace of change the communities are facing as a result of social and climate change. Therefore, if the introduction of the digitization process is placed directly into the hands of the weavers via a sustainable learning framework, it could support a new oral tradition and sustainable weaving future for the Cordillera.

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The Taxonomy of Chinese Traditional Revival Interior Design

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The traditional revival phenomenon has appeared in Chinese interior design throughout its history. Although academics have discussed it widely, the main research focus is usually on describing style changes. However, such descriptions cannot reveal the nontemporal relationship between the different styles or the design logic beneath them. With this background, this study aims to explore how and why the traditional revival phenomenon continuously appears in Chinese interior design history through categorising and subdividing the style based on a literature review, sample collection, classification, and site visit. The research found that reiteration, as a design logic, traverses different times and moves from foreign duplication to self-duplication, although various factors have played roles at different times, such as political definition in the 1950s, cultural influence in the 1980s and commercial considerations since the 1990s. Duplication was used as a method to search for national identity while responding to overseas influences.

Keywords: interior design, taxonomy, traditional revival, reiteration

1 Introduction

The exploration of national traditions in interior design has frequently occurred in modern Chinese design history because the development of contemporary Chinese culture always seems to swing between tradition and modernity as well as between national identity and international influences (Yang, 2006). According to Paul Ricoeur (as cited in Frampton, 1983), there is a paradox between universal civilisation and world cultures; thus, the challenge for third world countries is to modernise under the influence of developed countries while preserving their traditions. This paradox keeps affecting the modern Chinese interior design landscape, which makes the traditional revival, together with the recapturing of the regional culture, an eternal topic. Even though relevant design practices emerged in China as early as the 1930s, this paper focuses on discussing Chinese traditional revival interior design since the1950s while keeping in mind that interior decoration, which gradually developed into interior design, formally separated itself from architecture design in China in the 1950s.

Although traditional revival interior design is one of the most widely discussed topics in China, the leading academics, as shown in Table 1, is prone to focus on style analysis, which leads to only a description of the phenomenon. The disadvantage of style analysis is

its focus on the artist's personality and their design works' artistic features, which leads to a focus on grand designs because they are seen as having more artistic value (Fallan, 2010). Thus, interiors, as temporary arrangements for people's daily life trajectories, are ignored by the taxonomy of styles which dominate the history of art and architecture (Hollis, 2010). However, generally speaking, style analysis can be used as a starting point to explore the design logic beneath each style, as it showcases a coherent design appearance for understanding the perplexing design phenomenon. In order to overcome these disadvantages of style analysis, this paper is not going to discuss aesthetic value, the stories of famous designers or the relationship between form and function. Instead, the research is going to explore the design approach, the underlying design logic and the relationship between different subdivisions of the style. Theoretically, the subdivisions of the traditional revival style exist due to the reiteration phenomenon. As Kubler (1962) pointed out, the design of continuous duplication exists, as it traverses time and space forming a continuity. This paper aims to explore the reiteration variations of Chinese traditional revival style; it starts from classifying the style's subdivisions and their design approaches and then analyses the underlying similarities and the design logic behind them.

Table 1 Literature review on Chinese traditional revival interior design.

Authors	Research Methods	Research Topic	Conclusion
Zhang（2004）	Historical research	The development of Chinese interior design in the 20th century	From 1977 to 1999, the combination of traditional culture and modern form was the primary concern of Chinese interior designers.
Yang（2006）	Style analysis	The development of modern Chinese interior design style	designers take different approaches at different times, such as the eclecticism in the 1930s; the inheritance and adoption of national forms in the 1950s; new national patterns and regional exploration in the 1980s.
Huo (2017)	Style analysis	Chinese interior design history	This development was mainly reflected in style changes.
Dong（2010）	Style analysis	Interior design art development in the 30 years following the opening up policy	This development reflected the gradual dominance of aesthetic values.

2 Research design

The research begins with a literature review of books and dissertations concerning Chinese interior design history to search for clues about the traditional revival style. These books include *'Chinese Interior Design History'* (Huo & Huo, 2003), *'The Style of Interior Design and its Development'* (Zhang, 1999), *'Chinese Modern Interior Design Style Evolution'* (Yang, 2006). The dissertations are from Zhang Qingping, Dongchi and Zhu Zhongcui. Almost all of them are style-focused research, which acted as a starting point to get a general view of the revival style.

The review then continues by exploring design magazines to collect design samples mainly from *'The Journal of Architecture'*, *'Decoration'*, *'Interior Design and Construction'* and *'Interior Design'*. These magazines, except the last one, have a continuous publishing history on interior design and have influenced the industry to a large extent due to their high status in China. 'The Journal of Architecture', founded in 1954, was the first professional architectural magazine published in China; it has recorded China's architecture and interior design development. *'Decoration'*, founded in 1958 by Central Academy of Arts and Crafts which set up China's first interior decoration department, was the only academic publication of arts and crafts in China at that time. *'Interior Design and construction'*, founded in 1986 and later chosen as the journal for the Chinese Interior Decoration Association, has an enduring and wide-spread influence in the Chinese interior design industry (Zeng, 2002). Among all the periodicals, the journal most specialises in reporting and promoting China's interior design development. It assisted the setup of traditional revival conferences in the 1980s and 1990s and published articles about the conferences for coverage and discussion. *'Interior Design'*, founded in 1986, was one of the earliest magazines focusing on interior design. It documented the Chinese interior design industry until 2013, when it was renamed the *'Journal of Western Living Environment'* and shifted its focus to architecture. Additionally, some major design competitions are examined for references, such as the interior design competitions sponsored by the New Zealand Wool Bureau (1995–2001), the Chinese Interior Design Competition, the National Art Exhibition, and the Asia-Pacific Interior Design Awards.

Next, after the sample collection, the research creates a taxonomy of traditional revival interior design. The taxonomy starts by sorting out three main branches of traditions derived from international, national and regional factors, which are based on the previously collected samples. It then subdivides the variations of the traditions according to the similarities and differences between the observed variables. The sorting of categories seeks to minimise intragroup differences while maximising intergroup differences. As shown in Figure 1, the features that distinguish one tradition from another and the hierarchy behind the classification are the core issues.

Moreover, to compare documentation with real works, researchers select typical samples from each division to take site surveys when categorisations and their sub-divisions begin to take shape, as interior spaces bring spatial experiences which are far more complex than two-dimensional images could reflect.

3 Results and Analysis

3.1 Classification of traditional revival interior design

3.1.1 Style classification

People generally use style as a starting point to understand form features. Walker (1989) argued that style, which, results from a visual representation of artistic creation, emphasises and expresses form. Therefore, some scholars refer to style as visual ideology. This paper is not limited to defining a style; it mainly analyses the style's particular characteristics based on the classification.

The traditional revival, as one of the significant styles in modern Chinese interior design history, is a relatively broad field. It appears in different forms, namely as, international, national, and regional traditions. Generally, the international tradition refers to overseas

influences. The national one displays the self-reflection attitude facing the influx of overseas impacts. The regional one, which is relatively a flexible and inclusive concept, shows a more in-depth development of the self-reflection process.

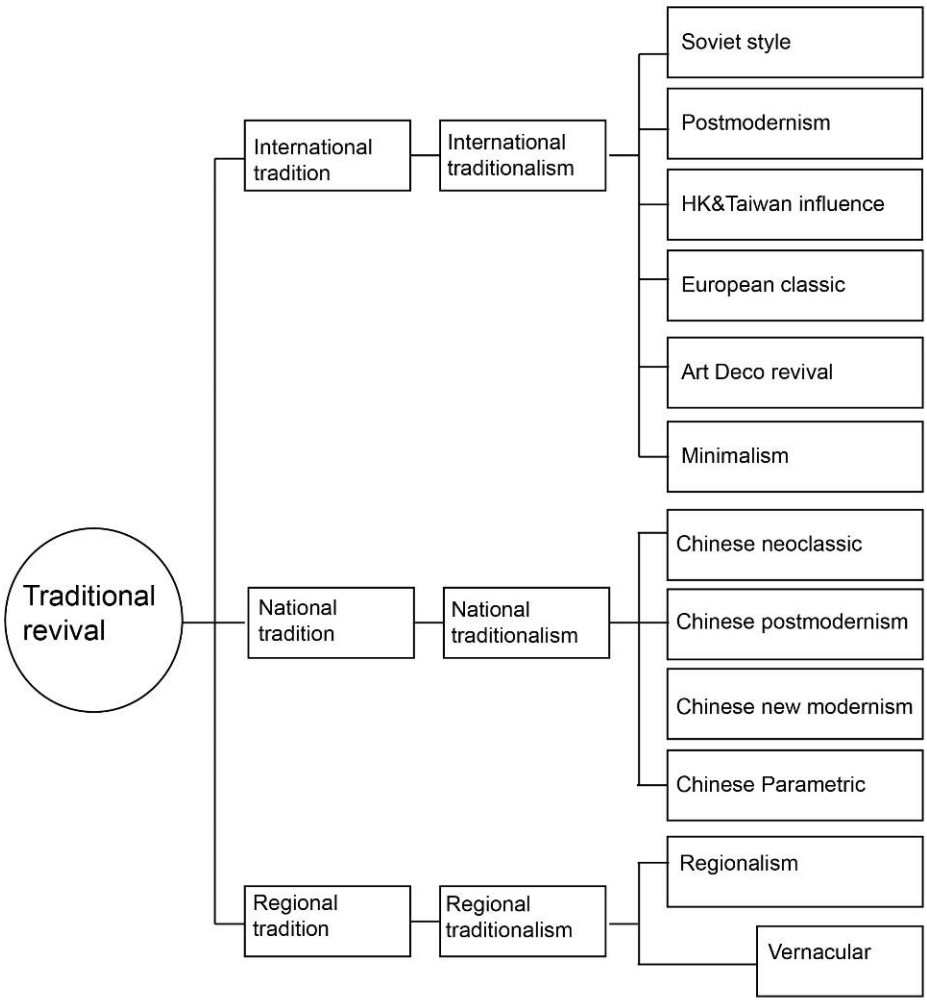

Figure 1 Classification of the traditional revival style.
(Hong Kong & Taiwan influence was classified within the international category because it worked as introductory variants of the Western classical style)

As shown in Figure 1, each category has a subdivision, which reveals a diversified state. Each group and subdivision share similar design motivations and appearances, whereas differences exist among the internal categories and divisions. Through the analysis of the similarities, differences and the relationship between the categories and divisions, the features of the traditional revival style can be better understood.

The international tradition represents the acceptance of relatively more advanced overseas civilisations. Among these civilisations, the Soviet Union was the first foreign influence in socialist China. In the 1950s, the Stalinist style or socialist classicism, which utilised eclecticism to reflect the Soviet Union's greatness, influenced socialist countries' architecture beyond the borders of Eastern Europe all the way to the Far East. At that time, China accepted Soviet Union's proposal and constructed four Soviet exhibition centres(Figures 3–5); the Soviet Union's architects helped to design the centres to showcase USSR's achievements in agriculture, industry, science and education (Li, 2017). These buildings'

interior and exterior decorations, based on socialist realism, used sculptures of workers, peasants, scientists and students, as well as motifs of wheat, sunflower, fruit and cotton to reflect socialist life (Zheng, 2018). In the 1980s, with the reform and opening-up policy, Hong Kong and Taiwan's influence — including modernism, postmodernism, classicism and neoclassicism — entered China, which helped form a complicated mixture of influences in China. During the initial stage, Hong Kong and Taiwan acted as a tunnel to translate European classical decoration languages into a style that became popular in the mainland. Through Hong Kong and Taiwan's introduction and interpretation, interior designers on the mainland began to realise the concept of interior decoration, which is mainly focused on moulding, veneer and Western patterns. Then, the designers began to seek the prototype of the Hong Kong and Taiwan style — the European classical style. With increased openness and more Chinese people going abroad, the European classical style, which in China generally refers to a mixture of different European traditional styles for decoration, become more popular. In the late 1990s, with an emerging affluent society, aesthetic simplicity, which was inherited from modernism, became a new trend. However, simplicity created a tedious and an emotionless environment, which made some people feel uncomfortable. At the same time, postmodernism, which utilises a collage of historical elements to showcase context, was wide-spread. Since 2000, Art Deco, which reflects historical details and a sense of craft, has become popular in China, as balances the need to show off not only wealth or social status but also the restraint of modern fashion.

National tradition shows the awakening of discourse on Chinese identity, which successively experienced political, cultural, and commercial context as responses to overseas influences. In the 1950s, Chinese neoclassicism emerged and expanded as a response to the Soviet Union style, especially after the political split between the two socialist superpowers in 1959. This style, which diverged from the Soviet one, retains socialist design ideas but replaces the Soviet decorative elements with traditional Chinese motifs. Since the reform and opening-up policy, after the imitation and digestion of the Hong Kong, Taiwan and European classical influences, interior designers in Chinese mainland began to return to their own classicism, no matter its imperial or vernacular traditions. In response to Western postmodernism, China sought to develop its own postmodernism by drawing inspirations from Chinese history by replacing the decorative elements with national symbols. Also, it is relatively more contradictory and complex than the 1950s neo-classicism which respects harmonious proportions and solemn compositions. Since 2000, parametric design, which represents the new development of technology and aesthetics, has emerged in China, notably after Zaha demonstrated its charm through her completed projects. Schumacher (2008) further proposed parametricism to resist modernism, as if the suffix with 'ism' strengthened his manifestation. However, the demonstration and manifestation have prompted Chinese designers to explore their parametric design either as a low-tech parametric strategy (Yuan, 2012) or as a context strategy (Xu, & Li, 2016), (Gao, 2016). The low-tech approach artificially constructs the parametric form while compromising on the parametric design's technological performance. The method moves to a tendency of mannerism, as its form oriented strategy leads to superficiality. Context strategy, on the other hand, tries to avoid formalism but fails to achieve conformity between tectonic and form.

The regional tradition reflects the rise of nativism. Regionalism is a relatively flexible concept. If compared with the West, China's exploration of national identity can be regarded as

regionalism. In terms of approach, the emphasis on the local environment and the adoption of local materials can be regarded as regionalism as well. Thus, nationalism and regionalism intersect with each other. In the 1990s, nationalism and regionalism were often discussed together. Lai (1991) regarded the historical context and folk customs as the inspiration for the creation of architectural design and the interior environment with national or regional characteristics. Shi (1996) believed that nationalism is the sum of regionalism. However, regionalism does not present a coherent image, as it changes due to different defining factors at different times. In the 1950s, China's participation in globalisation was relatively low and had a low level of industrialisation; the country had a less developed interior design profession. As a result of these factors, the regional interior design mainly stayed at the vernacular level inspired from traditional residential houses. As for the limited number of public buildings, the regional design used local motifs for architectural and interior decoration, such as the Xiamen University building complex and the Genghis Khan Mausoleum. In the 1980s and 1990s, regionalism began to serve commercial purposes, with emphasis on creating local landscapes. For example, the White Swan Hotel, built in 1983, created a Lingnan garden landscape, which reflected typical local characteristics (She, 1983). Wuyi Mountain Resort, also built in 1983, used local materials and crafts to reflect the characteristics of the northern Fujian province. Presently, critical regionalism in architecture, which has gradually gained influence in the field of interior design, shows new possibilities for interiors, as it tries to achieve a balance between universal rationality and national emotions. However, China is an exogenously developing country, and it started its modernisation and civilisation process relatively late (Shao, 2014). Thus, its traditional culture inevitably conflicts with modern civilisation, which has been dominated by Western developed countries. Critical regionalism transcends the vernacular architecture that emerges from the synthesis of climate, culture, myth and craft (Frampton, 1985). Compared with the design explorations in the 1950s, 1980s and 1990s, critical regionalism is undoubtedly a progression of ideas. As a matter of fact, the attention towards critical regionalism appeared quite early in the Chinese interior design field, although the design practices cannot match the theory of advancement. As early as in 2005, 'Interior Design and Decoration' magazine put forward a discussion on this topic.

To sum up, although the traditional revival style takes different forms, they have all acted as a response to overseas influences. During the responding process, revival reflects an exploration of Chinese national identity by adopting design ideologies and approaches learned from overseas and transforming them into the Chinese way of design based on inspirations from Chinese culture and tradition.

3.1.2 Design methods classification

The case studies found that the traditional revival interior design is reflected in four categories in terms of design approach: surface decoration, space scenery, artistic conception and space transformation. Among them, the surface decoration is the most common one, which appears repeatedly. Space scenery, mainly came about in the 1980s, first appeared in hotels authorised to accommodate international guests. Artistic conception appeared around the 2000s with cultural spaces as its main stage. Space transformation became prevalent as the profession absorbed designers with an architecture background. These four categories are shown in table 2.

Table 2 the classification of the traditional revival interior design according to the design methods.

Category	Design focus	Design elements	Typical sample
Surface decoration	Surface	Gypsum flower, wood lattice, moulding, relief wall, etc.	The Cultural Palace of Nationalities, China Grand Hotel
Space scenery	Shared space	Garden, landscape structure, miniature mountain, waterfall, etc.	Baiyun Hotel, White Swan Hotel
The creation of artistic conception	Artistic motif	The transformation of cultural relics and abstract motifs	Changzhou Grand Hotel
Space transformation	Space	Chinese traditional space arrangements	Chinese Embassy in Germany

Each of these four design methods has its own characteristics, but they do not entirely correspond to the style categories and their subdivisions. For example, as shown in table 2, Soviet-style and Chinese neoclassicism both employ surface decoration; postmodernism uses either surface decoration or spatial scenery; Hong Kong and Taiwan influences and European classical ones adopt surface decoration or sometimes spatial transformation.

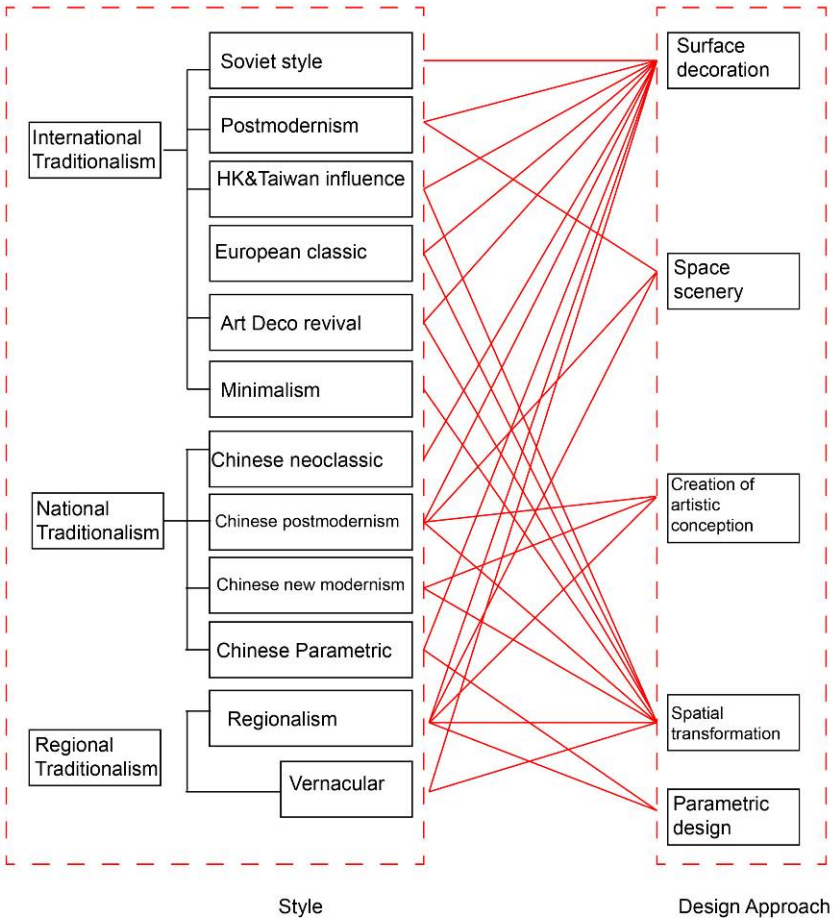

Figure 2 Schematic diagram of the relationship between style and design method.

The practice of surface decoration has continued from the 1950s to the present day. It follows the Soviet-style of decoration, with the building's interior and exterior surfaces as the main design focus, such as the entrance facade, ceiling, columns and background wall. Its design method utilises pattern configuration for decoration. The patterns are generally arranged according to the central and suitable corner patterns, whereas they are arrayed in two consecutive and four consecutive directions. Chinese neoclassicism continued to decorate in this way, but it replaced the decorative symbols with national ones; the People's Great Hall's decoration design is a typical example (Figure 7).

Figure 3. Images side by side showing Facade decoration of Beijing Exhibition Hall (left) and its motif details (right) (1954).
Source: Beijing architectural design and research institute co. LTD, 20th century heritage committee of Chinese Society of Cultural Relics (2018). China's 20th century architectural heritage canon: Beijing volume. Tianjin: Tianjin University Press.

Figure 4. Images side by side showing Facade decoration of Shanghai Exhibition Hall (left) and its motif details (right) (1955)
Source: Photo taken by author

Figure 5. Images side by side showing Interior decoration of Shanghai Exhibition Hall (left) and its ceiling motif details (right) (1955).
Source:Photo taken by author

Figure 6. Facade design of The Cultural Palace of Nationalities (1958).
Source: Wang, H. (2015). Chinese Contemporary Design Collection Series. Beijing: Commercial Press.

Figure 7. Images side by side showing interior decoration of Shanxi Province Meeting Room of People's Grand Hall (left) and its ceiling motif details (right) 2001).
Source: Wang, H. (2015). Chinese Contemporary Design Collection Series. Beijing: Commercial Press.

Spatial scenery, as a popular design method, appeared in the 1980s. it responds to the contextual needs of the interior environment. However, it varies in different ways. Postmodernism, for example, which reflects mixture and ambiguity, differs from regional and vernacular styles, which maintain authenticity. Zhuhai Jinyi Hotel showcases postmodernism characteristics by using brass palm trees together with stones and gravels for a collage of seaside scenery. Postmodernism focuses on patterns, cultural meanings and historical imagination, whereas regionalism advocates for the expression of local culture by showcasing local landscapes, materials and crafts. As for regional exploration, it tends to be consistent with the modern environment. Vernacular, on the other hand, does not seriously consider the surroundings, as it makes the context itself. For example, the atrium of Guangzhou White Swan Hotel creates a waterfall landscape, which can be traced back to the southern Guangdong traditional gardens but in a relatively modern way, as it is compatible with the quite modern architectural background. As for the Wuyi Mountain Resort, the architecture is constructed in a countryside image. The interior utilised local materials to make the scenery, which strengthened the vernacular context.

Figure 8. Images side by side showing Guangzhou White Swan Hotel (1983).
Source: Wang, H. (2015). Chinese Contemporary Design Collection Series. Beijing: Commercial Press.

Artistic concept creation began to appear mainly in the late 20th and 21st early century. It uses the techniques of traditional Chinese painting and enthusiastically expresses a space theme. For example, in the lobby bar design of Changzhou Grand Hotel, the designer placed dry tree branches in the light panel after treatment, which formed an effect of light and shadow that echoed through light irradiation. This kind of design emphasises the designer's understanding of an art theme, as he or she hopes to bring artistic feeling to visitors.

Figure 9. Changzhou Grand Hotel（2001).
Source: provided by Wang Qiong.

The method of spatial transformation emerged in the 1980s and became popular in the 21st century. It either refers to the application of modern spatial orders or traditional Chinese methods of arranging spaces. Modernism in architecture put importance to flowing space and to minimalising decoration, whereas, classicism in Western architecture emphasises facade and vertical decoration. Traditional Chinese buildings attach importance to the space arrangements in the horizontal direction, which makes it share similarities with modernism in architecture. To this end, the interior space of traditional Chinese buildings is relatively restrained in decoration, and they try to create rich experiences through space communication. For example, traditional Chinese buildings utilise the methods of opposite scenery, side views and borrowed scenery to enrich the space experiences.

Figure 10. Chinese embassy in Germany (1984).
Source: Zhang, Q. M. (1994) Interior design classics. Beijing: China Building Industry Press.

3.2 Form reiteration within categories

Why do certain types of interior decoration have similarities? According to social construction theory, knowledge is comprised of cultural tools. These tools exist in society before being internalised, and Individuals realise the internalisation of knowledge through their interaction

with the social environment. In design practices, designers frequently refer to precedents or existing design cases for help. Meanwhile, the clients might be influenced by their shared knowledge and understanding of interior space. Thus, the clients coordinate with the designers, resulting in a specific type of architecture and interior decoration similarly used before. However, it is worth noting that in typology, duplication does not merely relate to plagiarism. Steadman (2014) distinguished between duplication and modelling. That is to say, the model is a complete copy, whereas the duplication reflected in the building types is not a simple copy of the overall shape and layout. Duplication also does not mean merely copying parts and assembling them according to a standard set of rules. Therefore, duplication refers to a repetition of the basic features in architectural and interior decoration rather than the exact replication of specific decorative patterns. In the field of interior design, due to the complex details of interiors, even plagiarised replication has the topological features of a prototype and variant. At the same time, as technology develops, the variant changes of prototypes would be more intentional. In the manual era, hand printing produces roughly similar copying; in the machine age, mechanical printing created reproduction; and in the digital time, direct control of digital equipment creates accurate replication. Obviously, before the digital replication era, due to the uncontrollable factors during the transfer process, morphs are unavoidable.

This kind of duplication is similar to biological evolution. The theory of natural evolution provides a reference for understanding architectural reproduction. The change of physical form, based on specific rules, mainly comes from the shift in biological structure. Every turn of the biological system results from the previous change of form. Darwin's theory of evolution is primarily based on three points: mutation theory (as well as the theory of inheritance); variation theory (which we now know leads to gene mutations); and selection theory (Darwin's most lasting impact theory, which says each generation is based on adaptive genetic variation). In the late 19th century, biologists focused on how variation arose. The German biologist Ernst Haeckel tried to find clues in embryonic development (Kirschner, 2009).

Relatively speaking, interior design also has characteristics similar to biological duplication. All the new variants come from the adaptation to the new context with a balance between inheritance and mutation of the prototype.

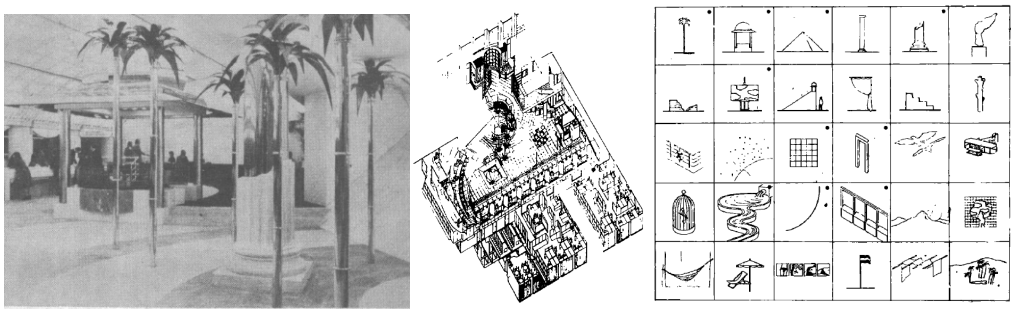

Figure 11. Austrian Travel Agency by Hans Hollein using brass palm tree for decoration(1970s).
Source: Mi, J. R. (1991). Exploration of the overseas - On the interior design of Austrian Travel Agency and Plaza Hotel. Interior,1, 18-19 and 27.

Figure 12. Zhuhai Jinyi hotel using brass palm tree for decoration (1992).
Source: Zhang, Q. M. (1994) Interior design classics. Beijing: China Building Industry Press.

Figure 13. self-duplication approach traverse different times.
Source: Wang, H. (2015). Chinese Contemporary Design Collection Series. Beijing: Commercial Press.

Moreover, the loose connection between function and form in interior decoration makes duplication have fewer constraints. Mostly, function plays a leading role, but it does not have a decisive significance. Patterns reflect the influences of many different elements, including politics, culture, economy and technology. Before the reform and opening-up policy in China, political factors had a significant impact on architecture and interior decoration. Decorative symbols reflecting socialist ideology can be seen in buildings with different functions. After these policies symbols indicating economic factors were widely used in buildings with different functions.

Besides, architectural and interior decoration patterns have disseminated more widely through such medias as publications, magazines, conferences, seminars and competitions. During the early years of the opening-up policy, these medias gained deep recognition. Examples include the '*Interior Design Knowledge Collection*', edited by the Central Academy of Arts and Crafts; the annual conferences by the Chinese Architectural Society's interior design branch (founded in 1986); interior design competitions sponsored by New Zealand Wool Bureau, and the '*Interior Design and construction*' magazine. At that time, because of the limited information pathways, these medias became the primary knowledge reference for many interior designers.

In terms of implementation, duplication includes external duplication and self-duplication. External duplication represents an international influence, whereas self-duplication stands

for the assimilation and the transformation of the original resulting in changes. When China isolated itself to the world except for the Soviet Union and its socialist counterparts, it allowed the Soviet Union’s architects to design exhibition centres in both Beijing and Shanghai, which created a model for Chinese interior designers to learn from. Then China began to advocate the Chinese national socialist style, which mimicked the Soviet Union’s way of arranging decoration with a Chinese motif as a replacement. And this kind of decoration method has left an enduring effect on Chinese interior decoration method to this day. When China began to learn from the West, Hong Kong and Taiwan played a role in translating the classic Western style. Later the European classical, modernist and postmodern styles influenced Chinese interior landscape greatly. As a response, traditional and national identity were discussed and practised frequently.

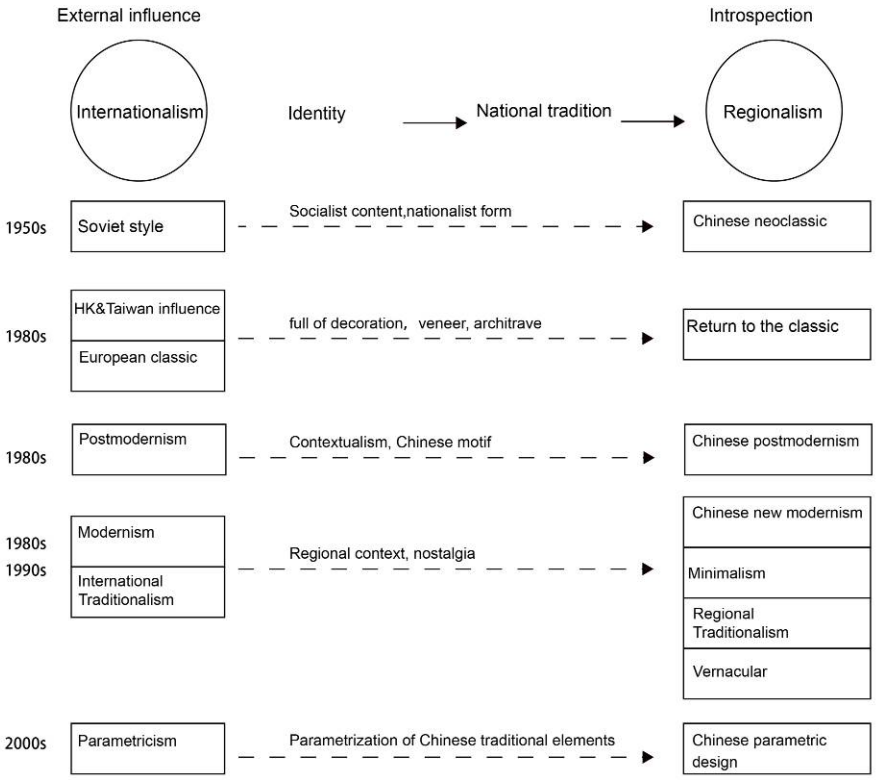

Figure 14. Relationship between Internationalism and the exploration of traditional revival for national identity.

Duplication exists in other circumstances as well. In architecture history, reiteration happens in various forms. During the period of neoclassicism, the Palladian motif was regarded as the basic rule for design. During the modernist period, Le Corbusier's Villa Savoye, which embodied the six principles of modernist architecture, became the typical paradigm followed by many designers. In the internationalist period, the 'uniform order' and 'clear construction' styles developed by Mies became the basic models for modernism and internationalism. His design of the Crown Hall at the Illinois Institute of Technology, Farnsworth House, the apartments on Chicago Lake Shore Drive and the Seagram Building all reflect the consistency of the self-duplication style. In the postmodernist period, the ironic treatment of a pediment on Venturi's Mother's House became a classic example of postmodernism, which inspired other designers later on; Philip Johnson's AT&T Tower is a case in point. As for the

digital period, self-duplication and duplication from others become easier to be realised, although parametric design opposes uniformity and advocates innovation.

4 Conclusion

The prototype of national and regional traditional revival explorations came from the introduction, digestion, absorption and transformation of overseas design influences. In the 1950s, the Chinese socialist design, which was advocated by the authorities, reflected the exploration of national identity which was led by political ideology. It tried to separate itself from the Soviet Union's socialism, hoping to realise socialist content in a nationalist form, although its design method kept following the path established by Soviet architects, including the Beijing and Shanghai exhibition centres. In the early 1980s, the traditional revival became connected with political objectives in the hotels which were authorised to receive foreigners, as they needed to showcase the positive images of Chinese culture and achievements to these visitors. Later, after opening up the country's door to the West, the notion of a national identity faced intensified discrepancy because of the influx of various Western styles. In the 1990s, under the influence of Western postmodernism, the political factors gradually faded away, and the traditional revival style began to become more relaxed and flexible, with scenic landscapes and collages of historical motifs becoming the standard ways to reflect the context. For the traditional revival style and its design approaches, design reiteration is the primary strategy, which traverses time and makes each subdivision of the style appear with a coherent characteristic.

However, as shown above, classification can define the natural attributes of different categories, but it cannot explain the variations within the same type. Therefore, it needs to be further analysed from the perspective of typology, which focuses on the study of transformation and variation features within the same category. Take the Soviet-style for example: the primary image of the 'Moscow Cake' (also known as the 'Stalin's high-rise') is highly consistent in Ukraine, Poland and China, but its variations in different countries cannot be analysed by employing taxonomy. Therefore, typology helps to explain variants within a category.

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Towards relational practices in design

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The article aims to build a notion of relational practices in design to rethink and reposition the professional practice in correspondence with other areas and places of knowledge production and reproduction, beyond Global North's rationalist tradition. It articulates ideas from anthropology, sociology, economics, philosophy and pedagogy authors. At first we explore the notion of 'relational', understanding it as a plural and situational perspective. Subsequently, we attribute it to design practices, positioning the latter within Global South's economic and political frameworks where particular historical, social and cultural contexts draw different practices. Finally, we focus on Latin American circumstances, arguing for relational practices in design with regard to daily challenges that constitute that specific reality. This reality includes the plurality of the Brazilian context and its complex social and environmental issues as well as unequal relations. The argument of this analysis points to democratization and articulation of spaces of debate, and to forge design practices as possible tools for resistance and emancipation of different political subjects. Thus, it proposes contextualized organic processes based on a continuous exchange between the actors involved. The under-construction concept of relational practices in design does not constitute a framework to the domains of research, teaching, and practice, but an epistemological perspective for them. The idea is to strengthen endogenous movements and contribute to a fairer society, which embraces new ways of thinking and practicing design.

Keywords: design epistemology; relational practices; decolonial design; emancipation

1 Introduction

This article presents and debates the idea of relational practices in design, from the political perspective of Latin American researchers, more specifically from Brazil. Departing from this context, our goal is to expand the design practice lexicon to a mediator of autochthonous processes –i.e. the one who establish a dialogue embracing cultural, social and economic aspects of each territory and which, from them, promote autonomy. By autonomy we refer to a continuous decision-making process of political subjects, based on freedom instead of dependence, as pointed out by Brazilian educator Paulo Freire (2015).

In our current global context, in which crises are intensified, it is fundamental to acknowledge the particularities of multiple contexts, recognizing different social groups –especially the

ones traditionally excluded[1]–, avoiding postures that are authoritative and standardized. Hence, design researchers and professionals have been searching for other modes of practicing design, more closed and connected to their surroundings. This aspect will be contextualized throughout this article and a variety of authors such as Ramia Mazé (2014), Maria Cecilia Loschiavo (2004), Bruno Latour (2008) and others have already been debating it. Thus, the idea of this paper is to reflect how design can work beyond a proposition practice in which finding solutions is the main goal, to build relationships that strive emancipatory processes.

Considering the design's hegemonic view[2], which does not fully capture the complexity of social actors and territories, we recognize the urgent and conflicting contexts for thinking and practicing design in current times. To this extent, post-colonialist Indian theorist Gayatri Spivak (2010) denounces that the traditional view of history tends to monopolize the perception of facts –anchored in a narrative based on hegemonic cores– privileging the maintenance of the prevailing order, as she affirms:

> This is not to describe "the way things really were" or to privilege the narrative of history as imperialism as the best version of history. It is, rather to continue the account of how *one* explanation and narrative of reality was established as the normative one. (Spivak, 2010, 36)

Panamanian philosopher Linda Alcoff (2011) denounces that the "systematic disauthorization of the interpretative perspective of the oppressed" –by central powers that hold the legitimation of theoretical knowledge– inhibits a possible route to solve intrinsic problems in the Global South. Alcoff (Idem) suggests that changing this theoretical framework requires an epistemological review under a decolonizing and pluralistic reconstruction of perspectives.

In this respect, her view on the unequal relations in stratified societies, composed of different identity markers, have yet to be considered. Identities are built upon a personal correspondence to the world and experienced events, carried on collective and individual narratives, memories, and discourses. From this point of view, the author (Idem) claims for a reform in knowledge production and its methodologies to ensure the inclusion of voices and experiences of identities, as well as skills, which are commonly marginalized.

Whilst considering different narratives seen in the plural contexts found in the Brazilian territory –distinct for inequalities and multiple identities in constant transformations– we understand the need to approach design to other areas of knowledge, especially social and human sciences. Such approximation aims to provide practices that recognize existing conflicts and differences, increasing our capacity for listening and dialoguing. As such, we borrow debates from anthropology, sociology, economics, philosophy, and pedagogy to think design issues.

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[1] By traditionally excluded we refer to social groups that are marginalised regarding the power of political and economic decision making: indigenous populations, craft associations, residents from informal settlements and peripheries as well as its organisations and associations, black women's organisations, informal street vendors, children and youngsters co-opted by drug and weapon dealing, women explored by prostitution, among others.

[2] As hegemonic view of the area we consider standardized and generalist practices, such as those exclusively industrial and for mass consumption –anchored in modern thought–; the design for social innovation that starts from European visions to think complex contexts that often are outside the Global North; design thinking and its focus mainly on solving problems of users rather than integrating them into design projects as propositional actors; among others.

To this end, we sought to rethink the role of female and male professionals, their positions, postures and their forms of relating to other ways of doing and living in society. This broader perspective not only revises normative conceptions but also gathers non-institutionalized contexts, articulating different spaces of knowledge. Our objective is to recognize in design practices the existing hierarchies and inequalities and debate a reconfiguration of involved actors in such relationships.

Brazilian anthropologist Eduardo Viveiros de Castro (2004) presents the concept of perspectivism. It comprises different types of subjective agencies, whether human and nonhuman, endowed with the same sets of capacities, generating different visions according to their own context. From this viewpoint, the author (Idem) raises another idea coined as "controlled equivocation" in which the equivoque is the result of estrangement between actors: researcher and interlocutor. Herein lies a negotiation of identities and communication supporting differences:

> The equivocation is not that which impedes the relation, but that which founds and impels it: a difference in perspective. To translate is to presume that an equivocation always exists; it is to communicate by differences, instead of silencing the Other by presuming a univocality —the essential similarity— between what the Other and We are saying. (Viveiros de Castro, 2004, 8).

In a similar path, British anthropologist Marilyn Strathern (1991) advocates for a thought capable of conjugating multiple worlds, studying the relationships with relations by means of partial connections. The author thinks of partial connections as an equivalent to disposing different elements in relation and emphasizing them despite conflicts and confrontations.

It is worth noting in contemporary design projects objective relations that pose solutions and yearn for innovative results as their main purpose. We have noticed there is a lack of thinking in design discipline capable of bringing different contexts together as well as engaging the practice with everyday situations of inhabitants located in formal and informal spaces, whether public or private. Brazilian philosopher and design researcher Maria Cecilia Loschiavo dos Santos (2004) suggests there is a detachment of design from contexts of severe vulnerability.

In this sense, the author (Idem) associates the ability of adaptation to precariousness, where spontaneous design practices emerge. There is an effective sense of improvisation, through which these populations, struggling in these contexts, adapt to conditions that challenge their daily survival. According to Santos (2004, 2), "spontaneous design is a creative practice of finding applicable work solutions to solve concrete problems, in contexts of severe lack of resources".

Indian architect Rahul Mehrotra (1998), while dealing with contexts of severe social vulnerability in Mumbai, India, points out to the disconnection of practice in a broader and more engaged panorama:

> Architects and designers working in these urban contexts are now dealing with an entire gamut of social, cultural, and economic issues and problems that are often alien to their professions. In conventional praxis, the professional architect does not engage in this wider set of issues but rather chooses to operate with the specificity of a site, in the process often becoming disconnected from the larger context of practice. (Mehrotra, 1998, 7)

As we deal with generations of design professionals who are trained on methodological structures based on operational concepts of design thinking and design innovation – additional to traditional Ulmian and Bauhausian modernist bases– the strategies of acting in congruence with urgent and complex social issues are not always deepened and given greater attention, as done in other social sciences areas of study. In accordance, design researcher Elizabeth Tunstall (2013) contrasts this view and advocates for a decolonized design engaged in cultural practices, which recognizes and enables voices and spaces to other peoples' and cultures' knowledge. In her own work, she sought to embrace aboriginal legacies, notions of respect in design and territorial knowledge exchange to rethink the design curriculum of Ontario College of Art and Design University in Toronto Canada[3].

Although such processes of decolonization are slow and have a high oscillation, design has been recently questioning the colonialist aspect of the profession, presenting other ways in which professionals can relate to practices and processes. Researchers Lauren Weinstein and Cinnamon Janzer (2015) are an example. They point out, with respect to the social bias of the discipline, that whereas designers immerse the social sphere –moving from designing objects to designing social changes– the need for an ethical social practice must be supported and developed. As an area of practice and research, design must adopt more appropriate tools and skills as well as modify methods that are inadequate for dealing with other social dimensions of class, race, and gender.

From such findings and situational focus, we think of fairer mindsets that consider existing differences as possibilities for mutual learning; exchanges that show different ways of doing and thinking; and ways of cooperating that recognize inequalities, avoiding aid perspectives. Since most local abilities and knowledge that permeate our territory are based on informality, we argue that Latin American context-based design practices are fundamental. They allow us to reflect upon social and cultural relations that are embedded and inherited. The gap between designers and social actors and their particular contexts requires other ways of relating, which fosters exchanges of learning and correspondence, as supported by Tim Ingold (2017) –explained later below.

By discussing the idea of relational we establish a link with different design strands: one embracing transitional aspects, as discussed by Colombian anthropologist Arturo Escobar (2017); one conjugating the design practice with anthropology, known as design anthropology, seen in the works of design researchers Wendy Gunn and Jared Donovan (2012), Gunn and collaborators (2013), and Rachel Smith and collaborators (2016); one in which designers and researchers act as co-actors in processes and projects, supported by British design researchers Lorraine Gamman and Adam Thorpe (2011); and others that focus on the intrinsic culture subjectivities of humans and their ways of interacting and living.

In this sense, the article is divided into three main parts that approach relational aspects to design practices, elucidating other modes of action, interaction and mutual exchange between designers and other subjects. Thus, it recognizes the responsive nature of design practice –a fraternalistic one– instead of placing total responsibility on professionals' hands through paternalistic perspectives (Gamman and Thorpe 2011). The parts of the article involve (1) an attempt to build a notion of relational; (2) an attribution of this notion to design practices in current social, cultural and political conjunctures; and, finally, (3) relational

[3] More information at OCAD University official website. Available at: https://www.ocadu.ca/academics/faculty-of-design.htm. Accessed on: 20 March, 2019.

practices in Latin American design, encompassing the Brazilian plural context, in its social and political perspectives.

2 Essay on the notion of relational

Before discussing the relational notion built upon design practices, we draw a path supported by anthropology, sociology, and philosophy of art to understand essential terminologies and concepts that allow us to theoretically explore the term 'relational'[4]. We seek to raise points, unfold and scrutinize the term towards its characterization addressing its notion to the propositional ability inherited in human beings.

In anthropology, Marcel Mauss (2017) reflects upon the exchange relationships between social actors and hierarchies among cultures and peoples. The author investigated and problematized the term "primitive" associated with these populations that were often classified as inferior societies. From his analysis, Mauss (Id.) reported a social and economic complex structure of benefits and counter-payments. This structure was not mediated by monetary exchanges and, therefore, acquired a condition of inferiority in relation to those who based their exchange on currency. By recognizing the differences observed in economic practices of such societies, the author unveiled a systematized knowledge about exchange practices as a propeller of social relationships, allowing an expansion of viewpoints beyond what is normative under Western culture traditions.

In this regard, anthropologist Roy Wagner (1981, 29) elucidates that all cultures can be understood as specific manifestations and he assumes that each culture is equivalent to any other, a phenomenon called "cultural relativity". We do not aim to infer that cultural relativity is relational; rather that it can support the construction of relational understanding.

Still under the perspective of cultural relativity, Wagner (1981, 3) writes that "the understanding of another culture involves the relationship between two varieties of the human phenomenon; it aims at the creation of an intellectual relation between them, an understanding that includes both of them". When we think of culture through relative objectivity, we can also rethink the design practices in ways that allow us to understand and include other spaces for action. The author (Ibid., 2) points out that the path to relative objectivity seeks "the ways in which one's culture allows one to comprehend another, and the limitations it places on this comprehension".

Viveiros de Castro (2013) points out that anthropological knowledge also implies social relations "since it is the effect of the relationships that reciprocally constitute the knowing subject, on the one hand, and the subject he comes to know, on the other". Thus, he continues: "As with all relations, this form of knowledge brings about a transformation in the relational constitution of anthropologist and native alike" (Ibid., 474). The author further clarifies that all anthropological knowledge is culturally mediated; in this direction, equality among knowledge does not imply an equality of rights, but equivalence in terms of knowledge.

From this perspective, we reflect upon design in an analogous way to the one posed by Viveiros de Castro. According to the author (Ibid., 492), "anthropology's constitutive role (its

[4] We understand the term 'relational' has been discussed in different applied sciences areas of study, including architecture, arts, and design. Nonetheless, we elaborate another conception of relational practices in design departing from the Latin American context.

task de jure), then, is not that of *explaining the world of the other*, but rather of *multiplying our world*". Inscribing design in this idea suggests that its task should not be of solving problems of different social worlds, but of multiplying, experimenting and establishing practices of correspondence[5] with other peoples, in other contexts, which also produce our material culture.

In searching for ways that multiple design cultures could allow us to understand other spaces, situated outside the formal context of the discipline, we reflect on paths that lead to propositional practices. These should be capable to connect different forms of knowledge, actors and contexts, not forgetting the limitations of observation and comprehension of these places. These paths, based on the relational bias suggested here, are shaped in the cooperation capacity of design in living rituals, which balance depends on exchanges, as elucidated by the sociologist Richard Sennett (2013, 93).

Once memorized, rituals "can give a shape to informal win-win exchanges"; (…) making "it possible for coalitions with strong and weak partners to work together for their common benefit" (Ibid., 5). Cooperation, however, lies in the human ability to juxtapose actions in daily rituals in which communities reveal their vocations in opposition to the logic of individualism commonly employed in the capitalist consumerist society. For the author (Id.), "cooperation can be defined, drily, as an exchange in which the participants benefit from the encounter".

As for the philosopher of art Jacques Rancière (2002), intellectual emancipation is equivalent to a condition of equality of intelligence: it does not mean that all the manifestations of intelligence inherited in human productions are of equal value, but rather we should understand them within a space of equality among all forms of action.

The author (2002) also rejects the existence of two types of intelligence separated by an abyss. Rather, he defends that the distance between various forms of intelligence should not be transformed into an abyss. The distance is not an issue that must be abolished, but a condition present in human communication. Therefore, as much as we need to recognize unequal contexts shown in design practices, it is also essential to consider multiple forms of intelligence present in human actions, in a democratic conflict between different and unequal ones.

From the notion of relational, we seek to understand this distance through a bridge between a variety of makers and producers of our material culture, designers and non-designers. We inquire how design practices could establish spaces of mutual exchange, recognizing the place where each participant is situated and considering their particularities.

Departing from our investigations within design research in the Brazilian context, a few experiences might be useful to illustrate such dynamics among different territories. From an urban perspective, the research of Harland and Santos (2008) and Montuori (2018) bring forward the existing unequal relations in the production and dispute of cities such as São Paulo, and Rio de Janeiro. Their works expose the forms people subvert the normative urban form towards a better quality of life in the city. As for the rural context, researchers Almeida (2013) and Nicoletti (2018) indicate the relevance of craftsmanship in the configuration of Brazilian artifacts, exposing the relations between labour, design and gender within these practices. What we would like to call attention is not the visibility that such

[5] We understand the idea of practices of correspondence from the work of anthropologist Tim Ingold (2017), which will be explored later below.

research promote towards marginalised communities. Rather it is the way each researcher established a rapport with the communities they observed and interacted. By creating relationships of trust and reciprocity, an open dialogue about multiple modes of living and production the material culture of the country is unveiled.

Finally, in an attempt to construct a notion of relational, we believe that it is immersed in the capacity of apprehension of daily rituals according to whom one works together; in the ability to promote intellectual emancipation, by recognizing the speaker's location (Alcoff 1991, Ribeiro 2017) and in the equality of knowledge and different value systems; in modes of cooperation and mutual learning; and in continuous exchanges that aspire a balance through otherness. For this reason, we understand the idea of relational as a mindset rather than a model, recipe or tool kit to be followed. The term has no single definition but an array of plural and situational perspectives capable of multiplying ways of reflecting upon our actions and relationships experienced by design. Following this path, we will now understand how this notion can be applied directly to design and its practices.

3 Thinking of relational practices in design

According to the above-mentioned points, we aim to depict a panorama in which the design practice is relational. Thus, we bring concepts that elucidate a practice aligned with this perspective. Among them, we rely on the text 'The Cautious Prometheus" by philosopher and anthropologist Bruno Latour (2008) where he speaks directly to designers suggesting an inevitable revision of the discipline and its practices.

The author (Id.) refutes the humanist vision, which is only concerned with human beings. In such vision, non-humans are treated as "mere materiality or cold objectivity" and, therefore, deals with objects as finished facts. Accordingly, the author addresses relevance to 'matters of concern', rather than confining ourselves to 'matters of fact'. He attempts to equally equate humans and non-humans in a relationship of care between all parties.

By changing their attitude, practitioners would rupture with old hegemonic styles of the modern that naturalize and segregate *non-human objects* from *human beings*, i.e. *things* from *people*. In this sense, the author suggests a design practice that promotes the idea of "drawing things together" in which matters of concern are emphasized at all times. This idea allows the expression and representation of all involved actors and their opinions in a project or process of collaboration, framing a design practice that is non-linear, objectified and reified (Id.13).

From another angle[6], anthropologist Tim Ingold (2012) faces social relations as a mesh of lines, which the lines are things and people and the knots are their moments of encounter. As follows, encounters occur through moments of reciprocity between the parts, which one answer to the other in a process that goes beyond interaction, which he denominates "practices of correspondence". Here we reflect upon these practices for design and support the notion of relational from the idea of correspondence as a possible path of action.

Based on Ingold's thought (2017), we assume design as a practice of correspondence in which professionals allow themselves to get carried away by local forms of making and by

[6] Although both authors (Latour and Ingold) have different forms of comprehending the entanglements between human and non-human actors –one through the concept of 'network' and the other through 'mesh'– and disagree in many of their theoretical productions, both elucidate relevant ideas to relational practices in design and thus, we carefully borrow bits from each author.

the apprehension of life dynamics, rituals and everyday life improvisations. To the author (Id.), correspondence is a way of relating to the other, adopting a posture of attention based on life experiences and habits of others in which agency emerges from within, emphasizing what is already in evidence. As such, the expression “doing undergoing” means in our view to follow the other, allowing us to be carried away as an important attitude to support correspondence, and thus, constituting a practice that is truly relational.

Even though it is not always possible to think of relational practices based on such ideas, as we open the practice to other actors we break the traditional cycle of problem solving to process emancipation (Di Salvo 2009, 60). Thence, the process is alive in people's hands even without the presence of a designer mediator, following their aims and hopes for the future (Gatt and Ingold, 2013).

In this manner, we recognize a design practice that involves different social actors, which requires an understanding of its political dimension. Design researcher Ramia Mazé (2014) emphasizes the relevance of thinking design under this perspective and how this approach implies an expansion of design roles as well as its current theories. For the author (Id.), these issues point to a micropolitical dimension of reproducing and reorganizing everyday social relations through design practices:

> Politics is always about the establishment, the reproduction, or the deconstruction of a hegemony, one that is always in relation to a potentially counter-hegemonic order. Design is always doing politics in the sense – it is always acting in the world to (re)produce social-spatial order or to rupture a particular order (Mazé, 2014, 562).

From involving several relationships and actors, we perceive the relevance of positioning design in a broader perspective of current economic and political factors. We comprehend the historical, social and cultural differences that the relational practice must consider when acting in determined contexts. In the following topic we build the relational practice according to the Latin American context, which is still less known and discussed in relation to traditional references of the Global North. To this extent, we gather a theoretical framework that draws from matters of concern found in the Global South.

4 Relational practices in Latin American design

While the Global North searches for experimental ways to challenge socio-political issues related to sustainable futures, climate change and migration, the Global South still defies conflicts of social housing, public space sharing, land exploitation and social autonomy. In the Global South context, particularly Latin American countries, inequality and complex social issues are everyday problems.

The wicked problems, as discussed by Rittel and Webber (1973) and later brought to design by Richard Buchanan (1992), still prevail and pose a challenge to designers. Fifty years ago, Brazilian designer Aloisio Magalhães believed that these same problems would be solved through industrialization in coordination with design projects (Magalhães in Souza Leite 2014). In reality, the scenario we face today is formed by many professionals immersing into fieldwork in order to attend everyday life demands, but with no preparation to get involved in the public sphere. Getting involved in the public sphere requires an understanding of the distance between unequal contexts as well as recognizing different actors and relationships that constitute these spaces to accomplish a relational practice.

Once again, the relational idea we are framing aims to develop an understanding of multiple viewpoints regarding social rituals and daily interactions. These provide engaging tools that unveil vernacular knowledge of traditional cultures and its socioeconomic strategies, as described by Colombian anthropologist Arturo Escobar (2007, 2016) and Ecuadorian economist Alberto Acosta (2016). The latter resorts to *Buen Vivir* philosophy as a proposition of society collectively built in the "cauldrons of long historical, cultural and social processes" (Acosta 2016, 23, translation ours). Acosta refers especially to indigenous peoples of Andean and Amazonian countries, pointing out these are living civilizations that face colonial modernity. *Buen Vivir* overcomes the traditional vision of development, introducing values based on reciprocity and solidarity to "build relations of production, exchange and cooperation that propitiate sufficiency" (Ibid., 27, translation ours).

The author (Id.) questions the real democratizing effect of technological advancements, since many of the new techniques are placed to perpetuate social inequalities. This is not to deny the advancement of technology that aim to enhance social capabilities, or to improve people's quality of life, but to respect and preserve other modes of living and their priorities. According to Acosta, this happens because the energy of creation is directed to concerns of a political and financial elite.

Hence, a multidisciplinary effort is needed towards solving the multiple scale world problems, revolving around a new economy. Among the main topics are: solidarity, sustainability, reciprocity, complementarity, responsibility, inclusivity, sufficiency, cultural diversity and identity, equity and democracy (Ibid., 163-164). By also considering ancestral and traditional knowledge –the ones usually not seen in institutionalized spaces–, we understand the relational role of design. Behaving as such means to enable the exchange between the actors from other collective ways of life.

The collective way of life is opposed to the widespread concept of progress. Escobar (2007) presents a reflection on the developmentalist discourse as another form of colonialism based on a concept of progress and modernization that has been imposed in most countries of Asia, Africa and Latin America after the Second World War. Through a chain of regimes that suppressed local cultures and identities, this process resulted in a scenario of violence, which in many cases immobilizes a possible articulation. In order to subvert the imposed developmental concept, it would be necessary to break with the current discourse, opening fissures that allow a development debate based on the promotion of social justice and local autonomy[7].

Escobar (2016, 213) also brings the concept of development when he presents the notion of autonomous design, which is sensitive and receptive to the questions presented by the collective. The author (Id.) advocates for a design for autonomy in which its basic structure relies on reaffirmation of identity, right to the territory and conditions for one's own autonomy as well as the construction of a vision for the future. In response to the suppression of local cultures, Escobar (Id.) suggests the realization of the communal. This line of thought provides conditions for continuous community-based inventiveness, an effective dialogue

[7] It is important to mention the work of Indian economist Amartya Sen who advocated for a development of freedom. He suggests that without a dignified life –including access to education, housing, transportation and other basic rights– subjects would not be able to determine what is the right path for their own lives. Thus, his work reminds us that such notion of development has already been debated. However, it is not widely embraced in design practice nor in its mindset. More information see: Sen, Amartya. 2001. Development as Freedom. Oxford: Oxford University Press.

with its surroundings and considers the articulation with other social actors and technologies to strengthen the community. Thus, autonomous design is an impetus for the creation of new emancipated forms of living.

From such processes of emancipation, Brazilian educator Paulo Freire (2015) proposes the recognition of cultural identity as one of the central themes to promote the emancipation of being through education. He suggests that respect is essential for a socially constructed cultural identity in community practice. In order to attain autonomy, it is necessary to stimulate a creative capacity so that one can respond to the "concerning questions" built upon common sense whilst supported by the scientific rigor towards a world comprehension. It is fundamental to think of ways to enlarge knowledge and expertise recognized as science, covering their approaches, methods and tools for an effective amplification of worldviews, beyond hegemonic factors.

The autonomy of being is obtained when the search for solutions is no longer spurious and, being critically supported, starts to find correspondences within its own time and territory as well as its own language and identity. Thus, we believe that relational practices in design are presented as an emancipatory political project[8], which presents them as a tool to promote autonomy, considering local cultural identity to stimulate cooperation between different social actors, pointing to a communal way of living.

Feminist scholar Bell Hooks dialogues with Paulo Freire (2015) when she adopts the perspective of a critical pedagogy, which aims to "redress biases that have informed ways of teaching and knowing in our society ever since the first public school opened" (Hooks 2010, 23). In her writings, Hooks (2010) argues about the need of pursuing all opportunities of decolonization and reinforces that this process of liberation is continuous.

Anthropologist Lélia Gonzalez (1988, p. 78) states that all languages are epistemic and, therefore, should contribute to our understanding of reality. In other words, there is the need of different epistemologies in order to comprehend different realities. According to her ideas, the universal form of understanding does not comprise the multiple contexts of knowledge production. As such, the author (Id.) advocates for a category of Amefricanity, which suggests a counter-hegemonic proposal to Eurocentric models embedded in colonialist and racist structures (see Almeida et al. 2018). Describing this category the author emphasizes:

> In addition to its purely geographical character, the Amefricanity category incorporates a whole historical process of intense cultural dynamics (adaptation, resistance, reinterpreting and creating of new forms), which is afrocentrated [...]. Its methodological value, in my opinion, is to allow the possibility of rescuing a specific unit, historically forged within different societies formed in a certain part of the world." (Gonzalez 1988, 76-77, translation ours)

Following this idea, Gonzalez (Ibid. 70) clarifies the existence of a whitening ideological veil, a mechanism that, despite recognizing the existence of other productions of knowledge, marginalizes and moves them to a place of the "exotic", the "folklore". What Gonzalez (Id.) proposes is that these places once displaced to the margins should be reallocated to the center. Along these lines, it is fundamental to think design beyond interdisciplinarity between institutionalized and legitimized knowledge. It means to situate its production amongst

[8] There are on going initiatives, such as Decolonising Design (http://www.decolonisingdesign.com), oriented towards thinking and practicing design from places other than the hegemonic ones, "*providing an outlet for voices from the fringes, the voices of the marginal and the suppressed in design discourse*" (Decolonising Design, 2019).

informal contexts, shifting it from the borders to the center of discussion and, consequently, the knowledge production.

As possible paths for relational practices in design, we list three aspects that guide this reflection:

1. Democratize the spaces of debate, creating plural places of commitment for a collective construction of proposals: in these spaces, cooperation between different knowledge, whether popular, traditional, empirical and/or scientific, must be articulated to allow other dynamics to flourish, breaking with the hierarchy imposed by the rationalist tradition;
2. Practice design as a tool of resistance and emancipation towards actively recognizing the speaker's location, adopting a posture that constantly revises institutionalized practices;
3. Propose processes based on local demands, exercise reciprocity and continuous exchange between the involved actors in order to promote correspondence between them. These aspects elucidate the inquiries covered in this paper and their possible ways to reflect upon the relational practices attributed to design.

From these paths and our own learning process during fieldwork –whether in Master, PhD or Post-Doc research–, we sought to delineate a theoretical framework to think relational practices in design, particularly in the Brazilian context. This framework acknowledges and articulates different rationalities and knowledge that permeate our territory. Observing the design education in Brazil, and its perspectives towards a critical and active learning, there is still a disconnection to reality. In terms of (un)sustainability, Lima (2018) advocates for a praxis based pedagogy that stimulates and gives opportunities for reflection and action for change. The author points out that a conception of a critical pedagogy in design education cannot be disconnected to reality, and consequently, to subjects, territories, practices and inherited knowledge.

In this sense, design –as a practice, research or taught discipline– should be immersed and thought through an endogenous movement that departs from local dynamics that institute different forms of living and thinking. Such trajectory is seen in Almeida (2013) and Nicoletti (2018) research, who investigated the artisanal practice of two communities in the Northeast of Brazil – Passira, located in Pernambuco State, and Várzea Queimada, in Piauí State. Both researchers problematise design interventions carried out in these places, indicating their inability to relate actively to the original territories where the artifacts are produced. They observed the lack of autonomy of communities in design projects, especially regarding the circulation of their products within new markets, outside of their workspace. The territory is, thus, encapsulated as a narrative to sell artisanal products. For this reason, it is fundamental that artisans are positioned as central subjects, actively participating in all project phases (elaboration, production, circulation and commercialization).

Within the context of informal settlements in Rio de Janeiro, Montuori (2018) worked directly with cultural producers from Maré, the largest assembly of favelas in Rio de Janeiro. Her investigation, focused on the modes of using and transforming the space collaboratively. During fieldwork she negotiated a relationship of reciprocity in which the space of doing research was at the same time an open space of dialogue with residents and their needs and aspirations. Together, several forms of collaboration were established, especially knowledge exchange activities involving sharing design tools and discussing critical inquiries about collective spaces for cultural production.

Finally, a relational practice of design becomes as a continuous exercise that seeks a non-hierarchical correspondence among the involved actors. This form of relation considers the multiplicity of factors embedded in cultural, social and economic territories that are located outside of central and hegemonic contexts. In our conception, thinking of relational practices in design, as an area of research and profession, is, after all, to reflect about the forms of recognition and the articulation of different knowledge and rationalities that permeate the territories in which designers intend to dialogue.

5 Final considerations

Writing this article started from our concern and unconformity as Brazilian researchers and designers about the meaning of thinking and practicing design. It comes from our personal experiences, especially dealing with informal spaces, and the paths and exchanges we could take from them. Over the course of the last four years, the term relational has guided us in the construction of our research. Our intention here was to present a perspective, rather than categorize another design strand, aiming to multiply the reflective ways upon our actions and relationships experienced in situ. We believe in plural viewpoints, thus, the concept of relational practices can contribute to other research and address new socially oriented practices, especially those outside of legitimized contexts.

The idea of relational practices in design –whether in research, professional activities or teaching– aim to contribute to the construction of a fairer society, which does not introduce totalizing concepts, but other ways of thinking and practicing design. Once attention is given with the same intensity to all social actors, guaranteeing the right of location for all speakers, broadening forms of listening, fairer exchanges can be ensured. We believe that this relational posture of design strengthens local autonomy through innate and autochthonous solutions. Finally, our intention was to expand and inquire how different contexts, social actors and practices can actively be considered and inserted within the design discipline. Refraining totalizing ideas, we perceive the notion of relational as in constant construction, suggesting plural perspectives, coexisting in their differences.

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Two Different Ways of HfG Ulm: Design for Industry and Design for Humans

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This paper focuses on the separation of the social and industrial pursuits of Bauhaus, which HfG Ulm intends to integrate into industrial design. Bauhaus had a dream of achieving and connecting social ideals with industrial production. They thought that teachers and students could contribute to the social benefits of sharing the fruits of the industrial age by supporting them in producing good quality products that are appropriate for the machine age. HfG Ulm also wanted to succeed the unfinished ideal. The belief in Max Bill's good form and Tomas Maldonado's "design as a scientific process" were never the same, but the background was full of both moral and social pursuits and realization through industry. However, the difference between the studio and the department, the difference between the industrial linkage and the knowledge learning, the difference between the design as the practice and the design as the academic has created the concept of environmental design harmonizing with the environment different from the industrial design which contributes to the industry. Industrial design cannot pursue social ideals, and if environmental design makes market-based judgment, it loses the characteristic of environmental design. Ultimately, the history of the HfG Ulm shows that the social pursuit of design and its industrial pursuit cannot be together.

Keywords: HfG Ulm; industry; society; environmental design

1 Two goals Bauhaus wanted to integrate

In 1923, four years after its launch in 1919, Walter Gropius, Dean of Bauhaus, redefined the link between design and industry to present “Art and Technology - a New Unity.” In the school establishment program, the word “craft” was changed to “technology,” and it became clear that art’s place in life would be through industrial technology. Unlike the 1919 program, the 1923 proposal clearly recognized that only machine production, not manual production, would enable art practices in everyday life. In particular, Gropius and his colleagues, with their socialist ideals that rejected the negative influence of capitalism and the poverty of the post-war era, set the goal of producing and distributing art using the technology of the time that everyone could enjoy.

The contradictions of capitalist and post-war conflicts of the time caused people who were in financial and social difficulties to think that revolution was necessary. Marx's political economy provided the critical logic of capitalist contradiction, and many who wanted to change welcomed the socialist revolution that destroyed the supremacy of Russia. It was generally attractive to pursue social values. Achieving the social value of coexistence in a

prosperous society has been understood as an important goal of design. In other words, if we can produce and distribute good-quality products at affordable prices that can be enjoyed by a lot of people, we expect to achieve materially equal social values. It was considered possible to integrate and pursue economic and social goals in design activities. The idea of this paper began with questions about whether it is possible to pursue the goals of industrial performance and social values at the same time.

As a design school, Bauhaus insisted on the integration of art and technology in order to achieve the democratization of art through production methods suitable for the new age. The concept of standardization pioneered by Herman Muthesius of DWB (Deutsch Werkbund) also played an essential part in Bauhaus's attempt to connect with the industry. Bauhaus people made prototypes of a number of products such as lightings, kettles, and steel pipe chairs, and contracted with the industry to produce and supply good products. Bauhaus GMBH was also established to facilitate production and sales operations. However, it is uncertain whether social values were realized. In 1928, Hannes Meyer, a certified socialist, was nominated by Gropius and appointed Dean of the school. Commercial performance during his tenure was doubled compared to the time before his inauguration, but he was driven out in 1930, just two years later. The school had been in existence for too short a time to fulfill what Bauhaus had intended. Moreover, it happened during the period of confusion that led to World War II, after defeats in World War I.

The Hochschule für Gestaltung Ulm (HfG Ulm) opened in 1953, just 20 years after Bauhaus closed, aiming to succeed the Bauhaus in Ulm, a southern city of West Germany. HfG Ulm was not able to last much longer than Bauhaus, and it existed at a time when the 68th movement, which broke up the post-war social order, was ripe and social confusion was intensifying. Nevertheless, HfG Ulm has been documented in the history of design as a school that set up industrial design education courses and as a good example of establishing industry linkages. HfG (school of design), the name of Dessau Bauhaus, was used in Ulm, and Tomás Maldonado, who was the protagonist of HfG Ulm, emphasized that the lesson of the Bauhaus Meyer era should be recalled. The aim of this paper is to examine whether the economic and social values that Bauhaus pursued were truly inherited by Ulm, the successor of the Bauhaus and well known for having created a new order. I would like to look into the possibility of integrating the two values that the designer considers simultaneously: designing for the industry and designing for humans.

2 The Beginning of HfG Ulm and its early achievements

HfG Ulm was founded in 1953 with the purpose of celebrating the sacrifice of the Scholl siblings who resisted the Nazis. The initial plan was to set up a vocational college with various departments, but this changed, and the School of Design was established. It was centred on industrial design and architecture, under the direction of Max Bill, a Swiss designer and architect who was appointed the first dean of the school on its commencement. He headed the construction of the Ulm school building. Bill was taught by Wassily Kandinsky, Paul Klee, and Oskar Schlemmer from 1927 to 1929 in Dessau Bauhaus, and Ulm's new building was based on the concept of the Bauhaus buildings. He recognized the undeniable principles of industrial production and wished to create purposeful and beautiful products in accordance with the economic and technological conditions of the time. However, his perspective on beauty was unique and powerful, and connected with moral and social values. He firmly believed that he could make life better through infusing a high aesthetic sensibility

into everyday goods. (Kapos, 2016) He held a tour of the "Die Gute Form" exhibition, which was based on his belief that he should wage a sacred war against bad form. (Sudjic, 2015) The Junghans watch, which was created through a strong business relationship with Bill, and the simple and functional Ulm Stool, are good examples of Max Bill's aesthetic philosophy.

Hans Gugelot, who designed the Ulm stool in collaboration with Bill, joined HfG Ulm as a lecturer in 1954, on invitation from Bill. From 1948, Gugelot, who received his architectural training in Switzerland, helped Bill in his work. He opened his own office in 1950, designing a panel-assembled module cabinet <M125> that could be modified and extended to fit the user's needs and environments. HfG Ulm's industry-academia collaboration was accelerated by Gugelot's involvement. The Braun Company, which was aiming to restore its postwar business, noticed an increased preference for modern lifestyles in a consumer survey conducted in 1954. As a result, the future direction of the transistor radio, which was its newest product at the time, was defined as "modern, clean and ordinary form, attractive material, bright color, reasonable structure and high technical value." New design development was needed, and Eichler, Braun's design advisor, invited HfG Ulm for the project. The results of the collaboration between HfG Ulm and Braun, led by Gugelot, were presented at the Düsseldorf electronic show in 1955. They succeeded in differentiating themselves against other competitive products with <SK1> radio, <G11> <G12> audio, and many other products. Even the exhibition stand <D55>, designed by the graphic design lecturer Otl Aicher, successfully demonstrated how different Braun was from the other exhibitors. The exhibition stand was a prefabricated and expandable grid that composed the space in a way that beautifully met the conditions necessary for the exhibition, including transportation and installation of the exhibits.

Figure 2. Junghans wall clock (left, Max Bill design, 1957), Ulm Stool (centre, Max Bill and Hans Gugelot design, 1954), and Braun SK4 (right, Hans Gugelot, Dieter Rams, Herbert Lindinger and Otl Aicher design, 1956).

In 1956, a turntable <SK4> was developed which replaced the wood traditionally used in household audio equipment with bent steel. It incorporated a thin and transparent Plexiglas cover, in addition to the metal plate body, which achieved a high level of aesthetics by revealing the neatly arranged functions within. Buttons, levers, and indicators were arranged in a designed grid, following vertical and horizontal function-centred visual principles. The layout of the control panel <SK4>, which was designed by graphic designer Otl Aicher, is a well-known illustration of the principles of modern functional design in the following areas: honestly showing interior devices, grilles, and materials which were earlier covered with wooden boxes in keeping with the stereotype "audio is a furniture;" placing the main focus on

the use of the product and getting rid of additional embellishments. One surprising feature of <SK4> is that even though it has no decorative elements, it gives the impression of an attractive fancy object because it conveys a brilliant and sophisticated feeling. It is ironical that <SK4> has become a collector's item for those who still adopt a functional style and enjoy retro objects. It cannot be ignored that the initial orientation of HfG Ulm and the influence of Max Bill was the pursuit of "beauty" and the creation of an intense feeling of high aesthetics.

3 Establishment of education model: Attempt to integrate industry and education

As can be seen from the criticism of Hannes Meyer when he left his position as the second dean of the Bauhaus in 1930, it was difficult for them to abandon the early artistic tendencies formed at the institution. However, it is impossible to ignore use, technology, demand, and price when designing a product that is to be marketed with a goal of being used widely. Thus, Bauhaus shifted from early expressionism to modelling for mass production, incorporating essential elements such as production facilities, rules, and educational content. Meyer introduced a more proactive scientific view of contemporary academic content related to the creation and maintenance of objects. However, Max Bill's view was different, even though he was a student during Mayer's tenure. On the basis of HfG Ulm's early motto of artist-designer education, Bill filled half of the curriculum with art education, including morphology, colour theory, and formative theory. Following Gropius' declaration of the integration of arts and technology, Bill's "good form" was also made possible by mass production that used contemporary technology. However, it was very important to him to have artists capable of aesthetic execution.

However, relatively young instructors, such as Tomás Maldonado, whom Bill hired in 1954, criticized the school's design sensibility as being scientific, not artistic. He also disapproved of Bill for responding to the complexity of the industry with an artistic approach to education with no consideration of the production process. Although Bill wanted to be considered the successor of the Bauhaus model, its founder Gropius publicly pointed out that what Bill pursued was not the Bauhaus philosophy, but more aligned to the craft school of the former Henry van de Velde. In the end, Bill resigned as rector in 1956 and left HfG Ulm in 1957, denouncing the decline of education due to excessive techno-centrism. Maldonado believed that the progress of the Bauhaus philosophy was possible only when it was reconstructed through progressive and original behavioural and educational ideologies, rather than following the educational content of the 1920s.(Lee, 1998) In Maldonado's view, Max Bill was no different from Raymond Loewy, a symbol of American capitalism-based design that encouraged consumption.(Kapos, 2016) In his view, there was a need for new educational content based on science and the modern era.

The core of HfG Ulm was industrial design, which creates products for mass production. Maldonado presented three new perspectives for industrial design at the Brussels International Fair in 1958: aesthetics, economics, and engineering. (Maldonado, 1958) Ironically, the aesthetic point of view was to insist on ignoring aesthetic significance. Instead, it emphasized that the elements of other industrial production should be considered as basic. He also emphasized the importance of function and market by referring to the need to recognize use value and exchange value from an economic point of view. He believed it was necessary to consider productivity and new technology utilization from an engineering point

of view. This perspective led to the reorganization of the new curriculum, and in particular, preparation for coping with the complexity of industrial design. It paved the way for the emergence of scientific theoretical education and courses such as artificial intelligence, game theory, operations research, and ergonomics. A new design education program was created, called the Ulm Model. It combined theoretical education based on scientific perspectives with practical training linked to “development groups” in response to industry referrals. After finishing the first year of the common foundation course, students received specialized education in one of four different departments.

4 Expansion of industrial linkage: Industrial design contributing to industry

The establishment of the Development Group however, was in fact a separation of education and industry. Students also participated, but the Development Group had additional freelancers and operated like an independent design agency. Part of the Development Group's revenue was deposited with the school foundation, Geschwister Scholl. This structure was similar to that of Bauhaus GmbH and the Bauhaus workshop. However, in Ulm there was a stronger independence of development apart from education, because the curriculum was department-centric rather than workshop-centric. The Development Group was established according to the design field, as if the school initiative was created in response to the field. Gugelot led group E2, focusing on home appliance development, Walter Zeischegg's group, E3, focused on small objects, Aicher's group, E5, focused on visual identity, and Maldonado's group, E6, focused on industrial products and product control.

After the Development Group was established, Braun asked HfG Ulm to establish Braun's comprehensive visual identity, from identity analysis and packaging design of audio product lines to user manuals, catalogs, letterheads, and exhibition stands. Gugelot and Aicher submitted a research report on the matter in 1959. Herbert Lindinger, a disciple of Gugelot, designed the hi-fi module system <F11> and <F12> as a graduation project from 1957 to 1959. Like Gugelot 's modular furniture <M125> and Aicher's exhibition stand <D55>, the concept of modularity and extensibility was applied to this audio system. It was a new prototype that included a reel tape recorder, tuner, and amplifier. <F11> and <F12> had many similarities with <SK4> in terms of its interface, cubic form, and systematization of elements. However, while <SK4> was a single product in which all the elements were integrated, <F11> and <F12> were very different in that they could be regarded as individual nodes of a network of extensibility. Lindinger's design was not commercialized until 1962, but then went on to become the basic concept of Braun’s audio product line in the 1960s.

Braun founded the in-house design organization in 1961, and Dieter Rams was appointed its department head. From Braun executives' point of view, it was a long-term business decision that would gradually convert the external support provided by HfG Ulm into an internal capability. The distance between Braun's location in Frankfurt and HfG’s in Ulm was also a problem. The CI and PI plans created with the help of Gugelot and Aicher lay the foundation for the independent operation of the design department. Naturally, since the design organization was established inside the company, the industrial relationship with HfG Ulm officially came to an end. However, Gugelot continued his relationship with Braun, leading to the success of the Düsseldorf exhibition, grooming the newcomer Rams, who had been recruited as an interior designer, and contributing to the overall design of Braun products. It can be seen in many instances that Rams was greatly influenced by Gugelot,

(Lee, 2012) but their relationship was not viewed as one between a teacher and student. At times, their conflicting opinions were considered on the level of equals or peers. For example, when Rams suggested the idea of a clear Plexiglas cover for SK4, and Gugelot insisted that the part should be metal, Braun's management adopted Rams idea. Since then, the transparent cover has become typical in this kind of turntable, proving that Rams' idea was appropriate. Rams did not put much weight on Gugelot's role when he had the opportunity to describe Braun's history.

Gugelot, who had experience setting up his own office and product development business before teaching at HfG Ulm, led the industry-university collaboration of HfG Ulm. In addition to his success with Braun, Hamburg's subway project with external freelancers was also successful. His Development Group, E2, also designed a wide range of products for companies like Agfa, Bofinger, Pfaff and Kodak, that included sewing machines, trains, cameras, copiers and slide projectors. In 1962, he moved his office outside the school and established “institut für produktionsentwicklung und design e.v.” (Gugelot Institute). As a member of the institute, Lindinger, who became a professor at HfG Ulm after graduating under the guidance of Gugelot, was involved in designing Braun products. The relationship between the institute and Braun was more like a relationship between a design agency and a company than like one between a school and a company. Even though Marianne Brandt, who did magnificent metalwork as a teacher and designer in Bauhaus, left the school, the students at the Bauhaus continued to develop historic lighting devices based on contractual arrangements with Kandem. Compared to that, Gugelot's influence was very large and much more personal in the relation between HfG Ulm and Braun.

Aicher's Development Group E5 designed chair advertisements for Herman Miller, an American furniture company, posters for the Deutsches Museum in Munich, color systems and Hannover Trade Fair exhibition stands for the BASF chemical company, CI programs for Lufthansa Airlines, cosmetic packages for Durodont, and so on. Maldonado, along with Gui Bonsiepe, designed products for office equipment company Oliveti and medical equipment company Erbe, as well as the symbol system for display and controls of electro-medical instruments.

This independent activity of the Development Group made the school-industry link seemingly strong, but it is difficult to claim that the Ulm Model, which was trying to harmonize theoretical and practical achievement, worked properly. Companies quickly recognized that HfG Ulm's capabilities delivered business benefits such as enhancing product competitiveness and increasing production rationality. This was also true of Kandem, who had contracted with Bauhaus, and it was clear that any form of industry-academia collaboration would only utilize the relationship with the school appropriately when it met business objectives. In addition, the professors who worked in the Development Group were unable to resist the temptation of rewards from the project, so they focused more on external projects to the neglect of their educational responsibilities. The students complained that it was difficult to meet instructors, even in class, and that the practical guidance sessions did not work well. Furthermore, design practice was separated from courses based on scientific theories, and did not match students' interest in society and social design. It was gradually evident that the curriculum of the school could not nurture the desired talents in the practical field. In the end, the activities of the Development Group were not recognized as university research activities, and the German government stopped funding the school. Bernhard

Buerdek pointed out that one of the reasons that HfG Ulm closed its doors in 1968 was that the school did not play a role in research and development. (Burdek, 2005)

5 Another pathway of function, the birth of environmental design

Unlike the seemingly active linkage to external industry, the internal process of establishing a new curriculum was not easy. With the introduction of the Ulm Model and the implementation of new curricula, instructors such as newly recruited mathematician Horst Rittel and sociologist Hanno Kesting supported the new direction that design should be based on science rather than art. However, their belief in science was beyond the forbearance of Maldonado. They thought they had to design objects using scientific methodologies that were rigorously based on mathematical computations and analytical studies. They even believed that unproven items should be erased from the framework of thinking. In their point of view, “value” lacked a rational basis, so they sought to remove all irrational, normative, ethical, and political elements from the design process, not to mention the realm of beauty.

Maldonado realized that they had fallen into methodolatry but was already embarrassed by the possibility that a coup attempting to overthrow the regime could take place within HfG Ulm's decision-making structure, where dissenters had become numerous. Since 1960, three young professors, including Rittel, had served as deans. Students also objected to that situation In 1962, about half of the students signed the following documents: "After four months of study we are deeply disappointed. [...] Teaching and research are not simply connected, for the institutes, of course, are taboo for the students. [...] We do not want to become sociologists, or physiologists, and certainly not structural theoreticians, statisticians, analytical thinkers, or mathematicians, but designers! "Maldonado, Aicher, and Zeischegg changed the rules so that the group presidency was lifted and only a designer could become a dean. After Aicher was appointed the new dean, he was able to regain control of the school, remove several science subjects, and restore practical content.

The curriculum determined the nature of the school, and it also embodied the ideological expectations that people had. Since the Bauhaus, people associated with HfG Ulm were concerned about the function, role and method of design. The main task of the academy was to set up a theory, to reflect it in practical education, and to revise the theory according to the outcomes. In 1963, Maldonado wrote in the Ulm Journal 8/9 that they needed to recall the value of the Bauhaus to discover the HfG Ulm way. He argued that Meyer's Bauhaus, though unsuccessful, had searched for a social role to correct the inhumanity of technical civilization. Based on that lesson, he suggested that HfG Ulm should try social transformation with the entire human environment as its target. (Maldonado, 1963) In Ulm Journal, 10/11, published in 1964, Maldonado and Bonsiepe addressed the limited function of science in the field of design, suggesting that both fantasy and method were necessary, and that there was a need for dialectical tensions between the two. (Silva Paiva, 2013) It was a gradual approach to balance the influence of science in design.

However, HfG Ulm was gradually losing the power of innovation. In 1965 Gugelot died suddenly, and in 1966, Aicher left for Munich. Maldonado resigned from HfG Ulm in 1967, when criticism of the Vietnam War became scandalous. After resigning, Maldonado, in his reminiscence of HfG Ulm, acknowledged the failure of functionalism. (Silva Palva, 2013) Though he thought that the problem would be solved with his good intentions, the task of

design was much more complex and subtle. In the same year, Abraham Moles, a sociology and psychology lecturer at HfG Ulm, published a theoretical explanation of the contradictions of functionalism in the Ulm Journal 19-20. (Moles, 1967) Ultimately, the realization of functionalism implies that things need to be optimized to meet human needs, leaving only what is necessary. However, functionalism cannot be achieved because the desires of modern affluent society differs from the philosophy of functionalism. In fact, as the Braun case shows, the more designers pursue product functionality, the greater the market competitiveness of the product and the company - creating an imbalance between production and demand. In the end, social optimization becomes impossible. In other words, if functionalism is applied industrially, it is a paradox that whatever intention and form it takes eventually becomes part of the business and loses good purpose of functionalism.

Maldonado then lectured and delivered seminars for three semesters at Princeton University and formulated his ideas into Environmental Design (Umweltgestaltung). It included the ecological aspects that had begun to spread at the time, not as a collection but as systematic and structural integration as Gropius' Gesamtknustwork architecture. The premise was that it should have macro perspectives, not individual product dimensions, in order to solve the holistic nature of functions and interconnected human problems. It was also intended to encourage industrial designers to aspire to contribute to social transformation by restructuring the environment from its passive auxiliary role in a consumption-oriented society to proactively encouraging consumption. (Warmburg, 2017) Maldonado’s Environmental Design evolved the notion of functionalism based on Bauhaus's production and social ideals, expanded the scope of function and made the concept clearer.

In addition to Maldonado, the concept of environmental design was welcomed by a number of HfG members, including Gui Bonsiepe, who confronted the idea that it is difficult to achieve social consideration due to the conflicting commercial demands of industrial design. Though ideas about environmental design are not exclusive to HfG Ulm, Maldonado, and Bonsiepe, it is clear that they are responsible for one axis of the discussion. After Ulm closed, from 1969 to 1972, Stuttgart University operated the Institute for Environmental Planning in the HfG Ulm building. Following Princeton University, Maldonado contributed to establishing Environmental Design as a subject at Bologna University and Politecnico di Milano University in Italy. Ezio Manzini author of the book “Design, When Everybody Designs: An Introduction to Design for Social Innovation,” taught PhD students from 1996 to 2009, following Maldonado in Politecnico di Milano. He organized the DESIS (Design for Social Innovation and Sustainability) network to explore further practical approaches to social design.

6 Separation of design for industry and design for humans

The industrial and social values initiated by Bauhaus can be seen as a conflict between practice and theory. Maldonado tried to write a practical and systematic manual on environmental design, but after his time at Princeton, he turned to theoretical discussions on the subject. The reason for this was that he estimated the level of environmental design to require political dialogues rather than micro manuals. In other words, if the concept of industrial design discussed at Bauhaus and HfG Ulm is a question of use and sale, environmental design is a matter of ideology, and they are not on the same dimension. Again, environmental design was a social and theoretical matter. The academic way,

another consequence of HfG Ulm, took a completely different direction from the industrial way.

Industrial design involves design for industry, designs that can increase market value for industry players. On the other hand, environmental design refers to designs that take holistic environmental conditions into consideration for human beings in natural, artificial, and social environments, rather than a one-dimensional ecological consideration. As Moles said, the idea of accomplishing social ideals through the expansion of production in a capitalist system was good but naive. Industry was a matter of survival and a matter of practical solutions, but it was not able to connect with social ideology. The form of modernism that Bauhaus sought through Kandem, and HfG Ulm sought through Braun, was also of interest to many other companies and is still popular today. However, we cannot explain the cause of the popularity only by the characteristic that the form is functional. Sustainability of objects is only possible when they are in harmony with social, economic, political, cultural, productive, circulating, material, personal, and even natural conditions. Of course, it includes vanity of being unrelated to traditional functionalism and a desire for kitsch. This is because it is one characteristic of being human. The idea is now spreading gradually that function is related to the surroundings, as Maldonado believed, and furthermore, it is contextual. If environmental design is sometimes understood to mean only the surrounding environment or be defined in a narrow sense of ecological consideration, the new design sensibility may now have to be called “connectivity design” or “context design.” Thus, HfG Ulm’s intentional and accidental attempt can be said to be a clarification of the meaning and limits of industrial design and an opportunity to embody the concept of new design thinking.

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Design of Translation: Reflections on Linguistic Practices in Design Research

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This article proposes a discussion about the linguistic and cultural frictions in design research from a French design research perspective. The DRS2018 conference provided a shared space to observe the diverse practices of design research in different countries and to question the reach of non-native English-speaking design researchers' voices as well as their strategies for adapting to a mainly anglophone research community. The first part of the article builds on two concrete examples that question the use of English as the normative framework for disseminating research: the policy of research dissemination in France and the semantics of the word design across languages. The second part of the article looks at young design researchers' strategies to discuss the different "academic bricolages" (academic makeshifts) they design to insert themselves in a globalized context. This article, written by a group of design PhD candidates, whose work cross the boundaries of other disciplines, aims at contributing to the continuous reflexion about design research and its practices.

Keywords: translation; linguistic; format; research accessibility; epistemology

1 Introduction

For a decade, a growing body of research practices has emerged in the domain of design in France. This growing community has crafted and developed a common language and common resources that meet academic norms inherited from the different disciplines from which the francophone design research community stemmed. In France, the English language has not been adopted in a uniform way by all academic disciplines and this creates some issues when it comes to sharing the research internationally. This article formalizes the reflections of a group of young French design researchers who presented their research at the DRS2018 international conferences. Organized by the Design Research Society, this conference was held at Limerick in Ireland from the 25th to the 29th of June 2018. During the plenary sessions, organizers had chosen to use the participatory tool sli.do (figure 1), to encourage participation from the crowd. This tool lets the audience share questions and reactions using their smartphones. Several times, the "#whyisdesignsowhite" hashtag appeared on the screen. That intervention aimed at questioning a design research perceived

as performed by and for privileged researchers. Even if the hashtag itself was focused on skin colour to evoke the de-colonialist approach to design research, it was opening a larger debate on several forms of dominations at stake in the practice of design research. For us, this debate sparked a second one: the question of linguistic domination in a discipline that keeps looking for the “multiple voices of design”.

The conference, originally organized by an anglophone association, happens entirely in English but brings together participants with very diverse origins: from South America to South-East Asia and the Caribbean, to name only a few regions. As one’s culture is intimately related to one’s mother tongue (Tornay, 1978), the cultural debate led to linguistic claims. One extract of the discussion on the platform (see figure 1) showed that using one’s mother tongue to debate in a mainly anglophone crowd is a strong identity statement, a sign of protest against a perceived domination.

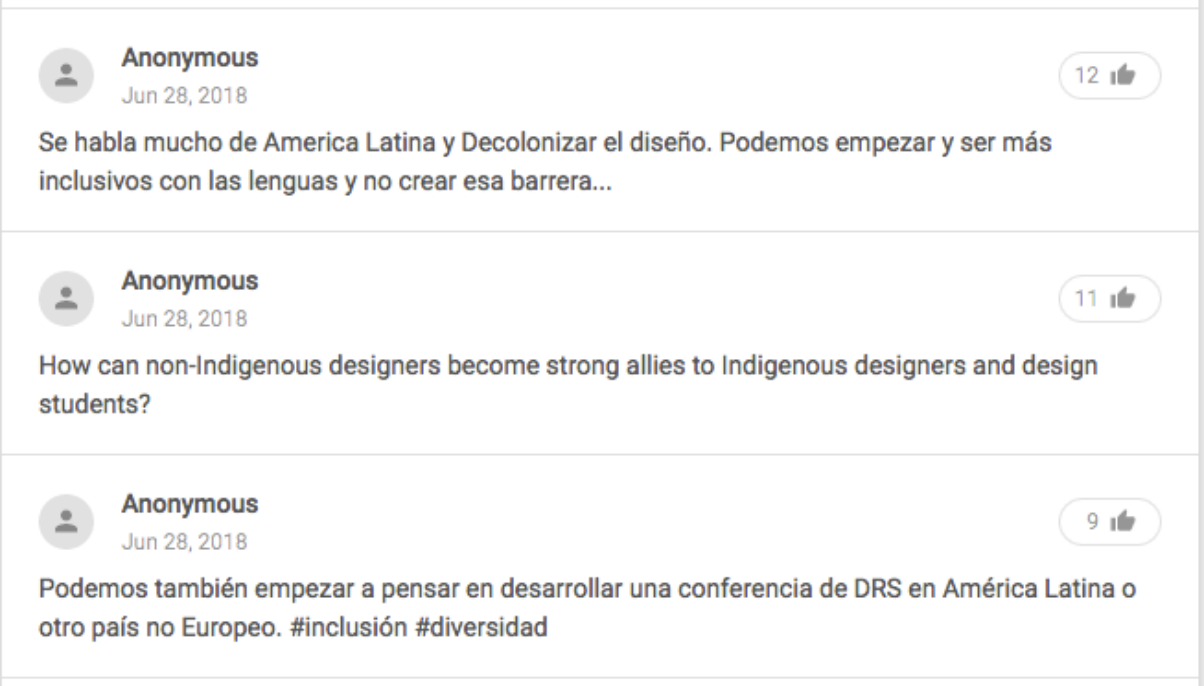

Figure 1: Screenshot of “sli.do”, an audience interaction tool, during the Social & Public panel (2018/06/28).

« Anonymous (June 28, 2018): People talk a lot of Latin America and decolonization. We can start by being more inclusive with languages and not create this barrier.

Anonymous (June 28, 2018): We can also start thinking about developing a DRS conference in Latin America or another non-European country. #inclusion #diversity »

As French-speaking researchers, this debate resonated with us and from the question #whyisdesignsowhite, and the reflections it sparked (see figure 1), we grew an interest in its variant #whyIsDesignResearchSoEnglish. The question of why design is so white has a strong historical dimension that calls for a debate about neo-colonialism and its effects on an international discipline. Here, our aim is not to compare profound racial issues with those linked to language, nor do we want to frame the French language as a victim of this issue. However, we argue that the so-called universality of design research materializes itself through the form of a language whose mastery of grammar and culture reveals strong

inequalities. In this article we explore the possibilities of plurilingual design thinking and its impact on the francophone design research community.

The first part of the article proposes a survey of the cultural and linguistic diversity of the DRS2018 conference. We contrast this survey with two use cases that question the adoption of English as a normative frame for research publication and dissemination: the politics of research dissemination in France as well as the culturally diverse acceptations of the word design. In the second half of the article we report on young design researchers' strategies to insert themselves in a context of localized but internationalized research. This article more broadly aims at contributing to the on-going reflections about research and its practices.

2 An overview of linguistic practices in design research

The Design Research Society defines itself as "a learned society committed to promoting and developing design research" (DRS, 2018). Established in London in 1966, it is the oldest interdisciplinary and international association in the design research community. A survey of participants at the DRS2018 (2018) offers a glimpse into geographical distribution of design researcher at an international level (see figure 2): 35 countries were represented through the laboratories of origin of the researchers for a total of 615 participants.

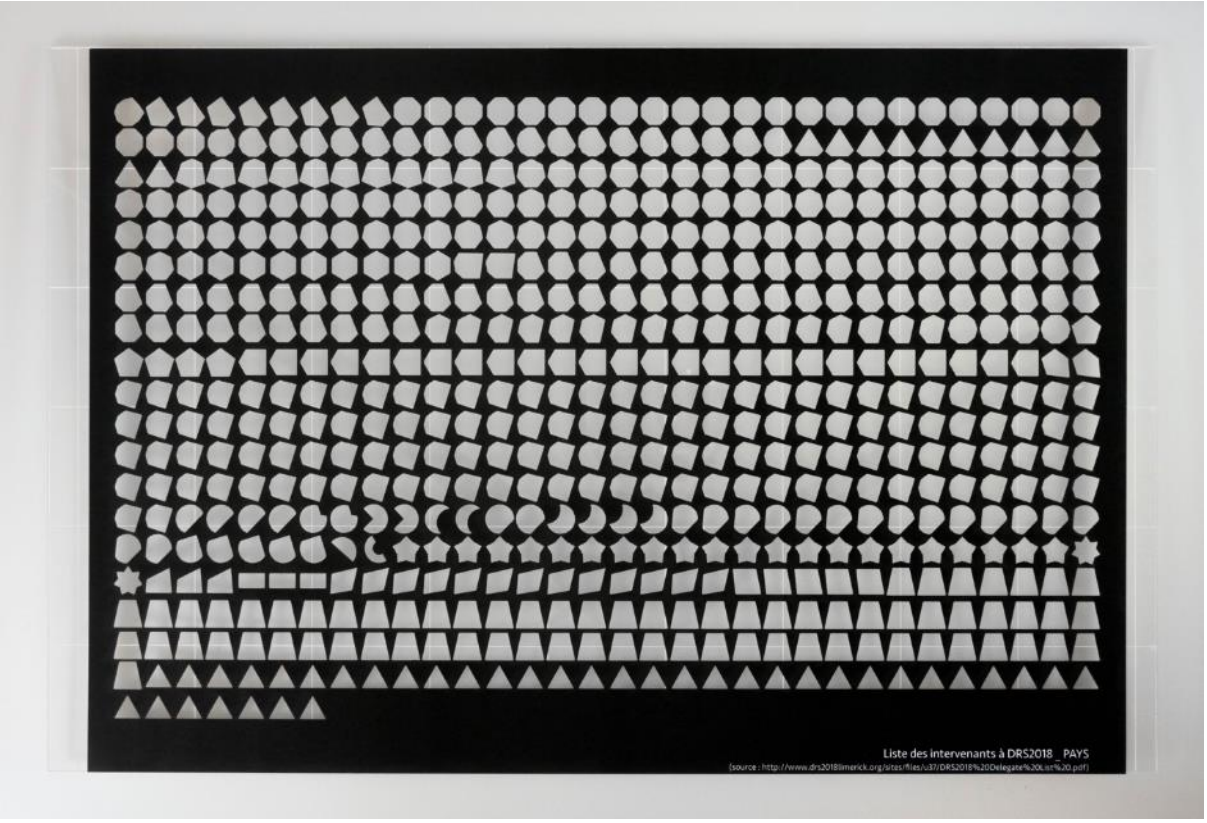

Figure 2: The 615 delegates at DRS2018 (and PhD by design conference) sorted by country. Each country is associated with a shape. Each country shape is unique but deliberately hard to distinguish from a distance, simultaneously providing an overview while revealing the plurality of origins.

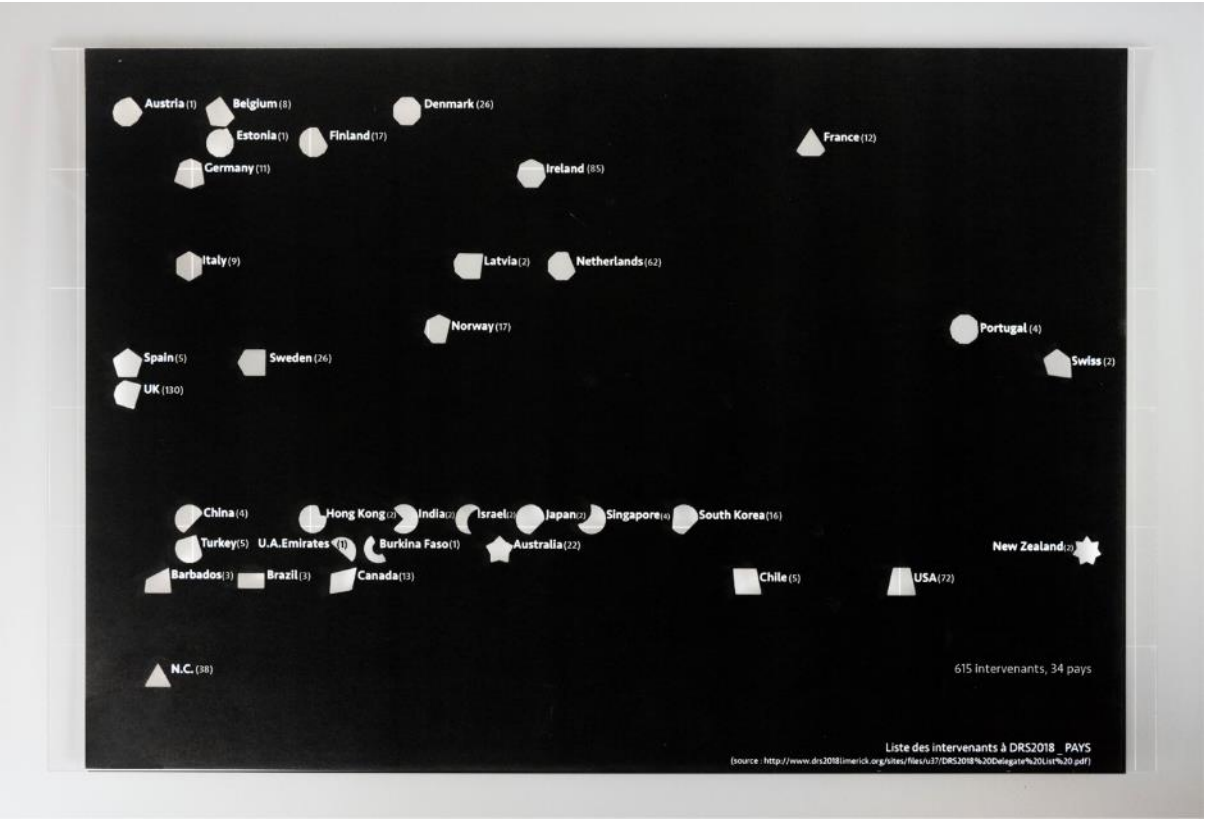

Figure 3: The 34 represented countries.

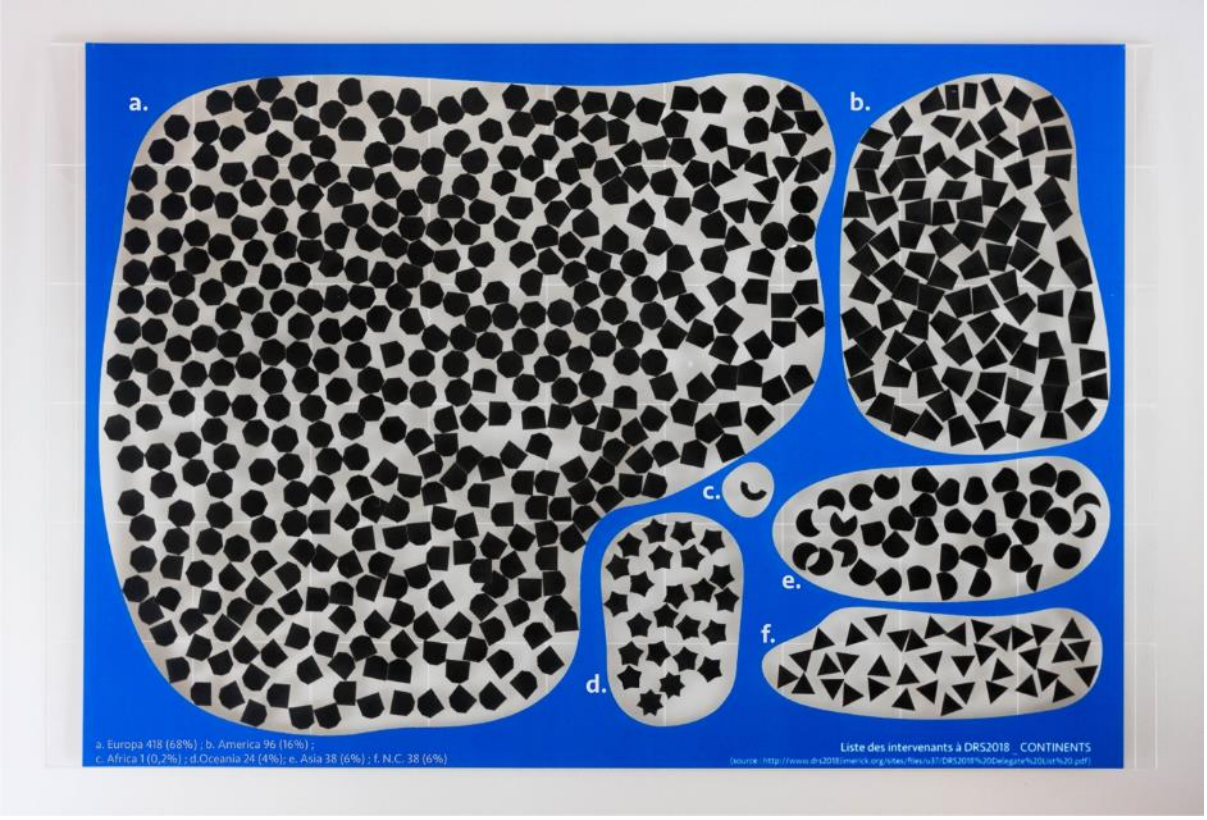

Figure 4: DRS2018 delegates sorted by continents. Europa 418 delegates (68%); America 96 (16%); Africa 1 (0,2%); Oceania 24 (4%); Asia 38 (6%) and Unknown 38 (6%)

Because the conference happened in Ireland and the Design Research Society being of English origin, the European Union community was the most represented (68%) (see figure 3 & 4), with 215 participants from the UK and Ireland. We can see that northern countries like Sweden, Denmark, Finland and Norway provided a total of 86 participants, to compare with 12 for France (with a much larger population) or 9 for Italy.

We found that English, used during the whole conference (scholarly articles, oral presentations and informal discussions) is the native language or the working language of 54% of the conference participants. It can be used daily by approximately 80% of participants in their professional context when we include researchers from Scandinavia or the Netherlands. Most countries (79%) represented at the conference speak a language of Germanic origin - English, but also German, Dutch, Swedish, Danish and Norwegian. Even if this can also partly explain the predominance of the English language in the conversations, a survey of geographical location of the laboratories revealed that 21 mother tongues were represented (see figure 5).

This predominance has implications, as we will see later, on the epistemological framework of the conference and questions the stance of a design research conducted in “minority languages”.

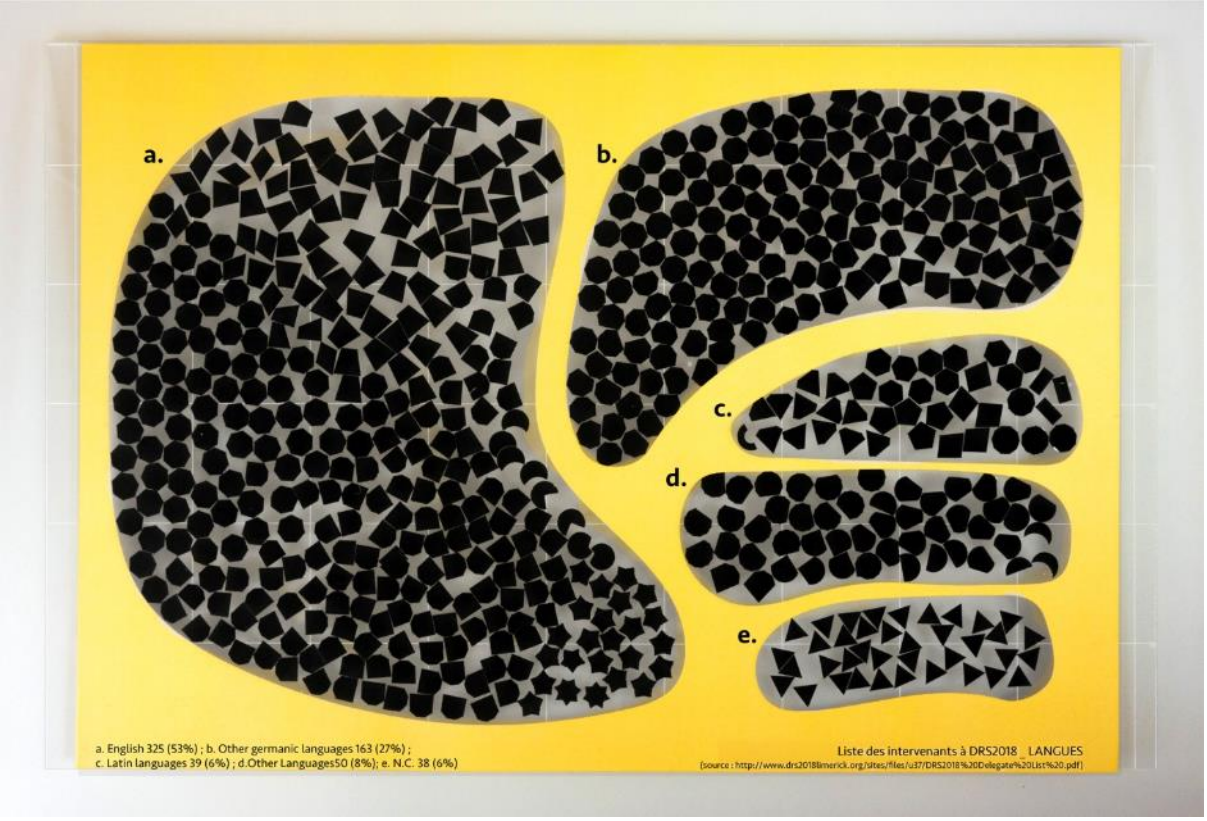

Figure 5 : DRS2018 delegates sorted by spoken languages. English 325 delegates (53%) ; Other Germanic languages 163 (27%) ; Latin languages 39 (6%) ; Other languages 50 (8%) ; Unknown 38 (6%).

2.1 The choice of language in the dissemination of research in France

The linguistic issues of French design research exist within a larger set of concerns that are transversal to all disciplines. In the context of the hegemony of the English language, the

linguistic situation of French doctoral theses reveals tensions about the choice of publication languages. Against the establishment of English as *lingua franca*, the proponents of an international influence and visibility of the French culture and language keep on debating. In 1994, the “Toubon” law (Conseil constitutional, 1994) established French as the language of teaching, business, commerce and public services, but did not forbid using other languages. Since its introduction, exceptions have been introduced for higher education as well as research in order to facilitate scientific partnerships and international degrees. Between 1987 and 2000, less than 3% of PhD theses are written in another language than French. In 2015, despite the Toubon law, the number of theses written in English amounts for 30%. Theses written in languages other than French and English remain rare (3%) and it is systematically for international theses (ABES, 2018)

The rapidly growing number of English theses reveals a choice influenced by academic constraints and internal logics (Slowe et al. 2018) to publish in Anglophone journals (such as Science [AAAS], Nature [NPG] for hard sciences and journals such as Design Studies [Elsevier] or Design Issues [MIT Press] for design). Because these journals have an international audience, they can display a higher impact factor and become a logical choice for young researchers like us.

This system pushes for publishing in English in order to facilitate peer recognition and to satisfy the criteria of research management. However, the choice of the language of the publication influences the way the research is going to be conducted, and especially the references that can be mobilized. Far from being trivial research practices, the choice of citation reveals multiple uses. “from a simple rephrasing in the context of knowledge dissemination to scientific endorsement, but also the promotion of the person citing through the exhibition of external signs of wealth” (Milard, 2012). It is logical, or even necessary to prioritize articles written in English as references for an article written in the same language, reinforcing once again the attractivity of that language. However, choosing to write in a certain language brings forward another issue: that of the role of language in the inclusion of the people for whom the research is conducted. Most of design research in France is conducted with and for people who are generally francophone. In that case, it is a real contradiction to write in English as it amounts to deprive these same people from the knowledge they participated in creating and that concerns them first.

This issue also raises the question of open access in scientific publication. Many European countries, including France, have recently passed laws to institute a right to freely publish research results (Robin, 2017). The case of PhD theses illustrates this interesting paradox of open access publishing. After the defence, the author - the doctor - authorises the open access publication of his/her thesis on the dedicated portal theses.fr allowing academic databases such as Google Scholar or HAL to index their work. This theoretically allows everyone to access and enjoy the research, but when this research is written in English, how well a francophone audience can really appropriate it? On the other hand, if the research is only written in French, isn’t it losing a large audience it could appeal to at an international level? This issue is especially crucial in design because the word design itself and the practices behind it are understood very differently across languages and cultures.

2.2 Polysemy of design, in French, English, Japanese and Chinese

During the DRS2018 conference, the strength of the linguistic unity obstructed cultural disparities around the situated nature of design practice. It led us to question the different

understandings of the word “design” and the ways it could influence design research around the world. First used in English, this word coming from latin (Midal, 2013 ; Vial, 2010) regularly brings confusion in France because it is used in a polysemous way in daily French. This plurality of meanings has for example been discussed by the French translator of British Anthropologist Tim Ingold (Ingold, 2017), explaining about the necessary semantical appropriation from one language to the other.

> “To these meanings of the word “design”, Tim Ingold adds many others in the text, taking advantage of the semantic richness of the word in English. Because French language does not have an equivalent word, we chose to translate differently the word depending on the context in which it appears, trying our best, as often as necessary, to refer to the english word in parenthesis. The verb “to design” was thus translated depending on the context, as “concevoir”, “former”, “créer”, “dessiner”. The substantive “design” was translated, depending on the contexts, by “design”, “forme”, “dessin”, “modèle”, “maquette”, “dessein”, “projet”, “plan préparatoire”, “dessins préparatoires”, “conception”. The substantive “designer” was translated, depending on the context, by “créateur” or “designer”.”[1] (H. Gosselin & H.-S. Afeissa, Trad. 2017).

Beyond the sole French case and because of different histories of adoptions, design does not refer exactly to the same activity in different languages and cultures. In English, because the term is both a verb, a noun and a substantive, it is largely used by all disciplines concerned with “conception” (one of the French translations of design when used in engineering, architecture, industrial sciences, etc). However, the adoption of the term and the concept of design in other languages was accompanied with semantic adjustments. For example, the English term of design was directly imported in Japanese (デザイン, design, pronounced /dezaiɴ/), but it had to position itself in relation to pre-existing words in the language, especially 設計 (sekkei, pronounced /se̅ke:/). This original term has taken the nuance of design as performed by engineers, while the term of design (デザイン) used in Japanese has acquired a more aesthetic dimension by contrast. In Chinese, where the term design has not been imported from English, it is the term of 設計 (pronounced shèjì) that is today used to talk about design in a much broader way, therefore maybe in a closer fashion to the English term of design.

This diversity in linguistic nuances can become a resource for the practice of design research itself. For example, in 1981, designer Tadori Nagasawa grouped and studied a set of artefacts that we would be describing using many different words in French or English (map, diagram, musical score, plan...), but that can all be described by the concept of “図” (Zu, pronounced /dzɯ/) in Japanese. This term “covers almost all forms of two-dimensional graphic representation, other than pictorial images and straight prose”. The designer used

[1] « À ces significations du mot “design”, Tim Ingold va en ajouter de fort nombreuses dans la suite du texte, en tirant le plus grand parti de la richesse sémantique du mot en anglais. La langue française ne disposant d’aucun mot équivalent, nous avons choisi de traduire diversement le mot selon le contexte dans lequel il apparaissait, en nous efforçant, aussi souvent que nécessaire, de renvoyer entre parenthèses au mot anglais. Ainsi, le verbe “to design” a été traduit, selon les contextes, par “concevoir”, “former”, “créer”, “dessiner”. Le substantif “design” a été traduit selon les contextes par “design”, “forme”, “dessin”, “modèle”, “maquette”, “dessein”, “projet”, “plan préparatoire”, “dessins préparatoires”, “conception”. Le substantif “designer” a été traduit, selon les contextes, par “créateur”, ou “designer”» Ingold, T. (2017). *Faire: anthropologie, archéologie, art et architecture*. (H. Gosselin & H.-S. Afeissa, Trad.).

this concept to explore a new approach to graphic design in his master thesis written in English at the Royal College of Art. (Nagasawa,1981).

It seems to us that those divergences in the understanding of the word and the practice of design, far from being benign, should instead have a central position in design research as an object of research in its own right. For this, we need to take into account the necessity of a dissemination of research in several distinct linguistic areas. In the second part of this article, we question the issue of translation in design and we explore the connection they can have with the making of design research as a discipline in a French context.

3 Examples of linguistic configurations in research in design

> If the translator neither restitutes nor copies an original, it is because the original lives on and transforms itself. The translation will truly be a moment in the growth of the original, which will complete itself in enlarging itself. [...]. And if the original calls for a complement, it is because at the origin it was not there without fault, full, complete, total, identical to itself. (Derrida, 1985) [2]

Derrida (1985) presents here the act of translating as a growing creation, performing a transformation of the original text by completing it, enriching it. In the foreword section of Alessandro Mendini's text collection (Mendini, 2014) Pierangelo Caramia also describes this process of mutation of the initial text. He tells the journey of the translation he is proposing and the questions that inevitably arise when transposing the words of an author from one language to the other. He explains that the act of translation is to be considered as an "architecture and design project in its own right" that gives access to non-italophones to Mendini's project. If research aims at sharing and disseminating the knowledge it is producing, then the act of translation could be one of its shapes. Answering the questions raised during the DRS2018 conference, we chose to reference and discuss noteworthy initiatives set up by francophone researchers in order to facilitate multilingual research.

3.1 Between language and context, "façons de faire" (ways of doing) in design PhDs

We noticed that francophone researchers generally need to balance between several languages and make their own translations. These choices are guided, among other reasons, by the affiliation structure, the discipline but also the environments of her field work.

Some disciplines historically require English as working language for publication. It is especially the case for PhD thesis in human-computer interaction, like the research work of Nolwenn Maudet, computer science doctor at INRIA (Maudet, 2017). Even if most participants she worked with were francophones, her PhD thesis, Designers Design Tools was entirely written in English, allowing an anglophone audience to read about the practices of French designers. The text is also accompanied by drawings illustrating their actions.

Some design researchers immerse themselves for a prolonged time in the environments they are studying. They are sometimes facing anglophone fields even if their whole work is produced and disseminated in French. It is the case for Camille Bosqué (Bosqué, 2016), doctor in aesthetic at Rennes 2 University who conducted a field inquiry in Fab Labs,

[2] « Si le traducteur ne restitue ni ne copie un original, c'est que celui-ci survit et se transforme. La traduction sera en vérité un moment de sa propre croissance, il s'y complétera en s'agrandissant. [...] Et si l'original appelle un complément, c'est qu'à l'origine il n'était pas là sans faute, plein, complet, total, identique à soi. » Derrida,J. (1985) « Des tours de Babel », dans : *Difference and Translation*, Ithaca, Cornwell Press, Joseph Graham. p. 222

hackerspaces and makerspaces in India, Norway, the United States and in France. Even if the interviews were partially conducted in English, the field notebook and personal notes of the researcher are written in French. In order to integrate the interviews in her PhD thesis, she chose to translate them in French in the body of the text and to put the original verbatim as footnotes.

This choice allows readers to appreciate subtleties of the language and potentially making their own translation to avoid interpretation biases. This choice also allows the researcher to take into account the context of the interview as well as her experience with the field in her choice of words for the translation. She also decided to accompany interviews with sketches that visualize the spaces discussed and contribute to their understanding, beyond words.

3.2 Translation as a contribution to design research

In his thesis conducted at Paris 1 University, Anthony Masure (2014) considers the act of translation as a pedagogical project and proposed the first translation of a Vannevar Bush text (1945) in French. This text, written in English, was a critical reference for the structuration of his thoughts. Translation could be considered a contribution to the field of design research. Passing from one language to another implies a meticulous work to render the complexity of an author's thoughts while simultaneously considering the heritage and the production context, be it disciplinary, historical or cultural.

Design journals try to propose solutions in order to universalize their content and thus grow a larger audience. It is the case, for example, for the bi-annual journal Azimut (2018) that is distributed both in France and abroad with bilingual content. A similar accessibility effort is also visible in Back-Office (B42, 2018) a journal dedicated to graphic design research. In the case of the later, a translation and definition work of originally English words or notions that do not have French equivalent has also been conducted. The issue of translating from one language to another in order to disseminate and spark discussion is not only a francophone endeavour. For example, the special issue "Design Research in Germany", (Chow et al, 2015) published in 2015 in Design Issues suggests an interesting direction. The issue presents in English recent Germanophone design research perspectives as "most of these perspectives are seldom known outside of Germany—mainly because of the language barrier."

It is why, in this article, we chose to systematically propose as footnotes the original versions of the non-English citations we used to make our translation work visible. This article was originally written in French, for a French design research audience and we translated it to disseminate these ongoing reflexions with the anglophone community.

4 Conclusion: beyond words

Taking as a first stepping stone our common experience during an anglophone design research conference, we explored the impact of language on our research practices. As we were exchanging and writing this article, numerous examples and situations appeared to be relevant to the conversation and the list of topics we wanted to explore seemed dizzying. We thus removed parts, discussed again and chose to question language across two different axes: words and disseminations. These themes can be seen as two extremes of the researcher work — the choice of words while writing and the dissemination method of the finished project —, they are also at the heart of issues that young researchers need to tackle.

This overview leads us to say that language diversity, beyond its role in cultural growth, has a role in dissemination that design researchers need to question. In our experiences as design practitioners, we did not feel the language barriers as strongly as in design research. Using images and objects in this profession appears to us as a source of inspiration to integrate in our research work. Because language can sometimes appear as a normative constraint that penalizes research, going beyond words is a promising avenue.

Following the Annotated Portfolios (Gaver & Bowers, 2012) or Pictorial format established in some conferences (DIS, 2018), initiatives try to question the role of images in scientific knowledge production. Far from being anecdotal, these questions of form within the community are real opportunities to seize. As Emeline Brulé and Anthony Masure (2015) mentioned in their article about thesis formats, designers' experiment with many different formats, but it is still hard to get institutions to accept these formats as legitimate research artefacts.

As for English, young researchers often feel torn between the will to renew ways of doing in their disciplines and the incentives to respect established norms to exist in the globalized research ecosystem, but we hope that this work will contribute to showing the many possibilities given by a *design of translation*. Indeed, it seems that designers, often at the interface between several field, could bring some news perspectives on translation in research works.

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DESIGN REVOLUTIONS IS ABOUT THE NOVEL AND THE NEW SO WE ENCOURAGE OUT OF THE BOX THINKING, SO CHALLENGE CONVENTIONS AND PROBE THE NORM. WHAT ARE THE CRITICAL DEBATES IN DESIGN RESEARCH? HOW SHOULD DESIGN RESEARCH ENGAGE WITH OTHER DISCIPLINES AND WHAT NEW FORMS OF INTER- AND MULTI-DISCIPLINARITY WILL EMERGE? WHO ARE THE KEY THINKERS AND DOERS IN DESIGN AND WHY? WHAT IS REVOLUTIONARY THINKING IN DESIGN RESEARCH?

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A framework analysis of the “open paradigm”. Four approaches to openness in the field of design.

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Open design is a term that expresses a plurality of meanings and, according to the literature on the subject, is difficult to define due to due to the variety of its practices and applications. This research study seeks to examine the opening phenomena related to design by imagining a more extensive and articulated area that may be called the “open paradigm” in the field of design. Starting from the analysis of the 20 case studies cited most often in the literature on open design, the research study outlines a framework for the “open paradigm” by identifying four different approaches to openness: OS – Open source approach, CO – Collaborative approach, CR – crowd approach and OM – open manufacturing approach. These approaches are not new to design research, but they are often studied within the confines of their own contexts. The paper explains each approach in written and visual form, to synthetize the different modes of operation in relation to the design process, analyses them as part of a system and concludes by identifying the attributes of each approach in term of dynamics, tools, resources skills and the role of the designer.

Keywords: open paradigm; open design; co-design; crowd design, open manufacturing, design theory

1 Introduction

Since the origin of the design discipline, the notion of “design” has been deeply connected to industry and mass-production (Maldonado, 2003; Dorfles, 1072). According to Celaschi, Formia and Garcia (2010, p. 63) “Design is the culture through which this relationship between art and industry progressively, and not unitarily, takes shape”. Though the connection with the origins remains very strong, the exclusive bond between industry and design has loosened over the years. The design discipline has gradually become more articulated and fragmented into a multiplicity of different sectors of intervention by partially hybridizing its industrial origins (Yee, Jefferies & Tan, 2013) and integrating the participation of different stakeholders into the design process, such as non-designers (Sanders, Brandt & Binder, 2010), professionals from different fields or institutions.

In the last few years, one of the most hybridized areas of design is the one identified with the expression “open design”. As shown by Boisseau, Omhover and Bouchard (2018), the academic literature on open design has grown, and knowledge of this phenomenon has increased both through the definition of the practice and the analysis of case studies.

Literature on the subject agrees that this expression refers predominantly to the open source process applied to the design of physical objects (Van Abel et al., 2011; Menichinelli, 2016). Nevertheless, some authors underline that this area is difficult to define because it embodies many different connotations and related concepts such as co-creation, crowdsourcing, DIY (do-it-yourself), open innovation, and many others (Cruickshank & Atkinson, 2013; Aitamurto, Holland & Hussain, 2015; Boisseau, Omhover & Bouchard, 2018), synthetized by Gasparotto (2019) in three different main features: open source, collaboration, and access.

Related arguments such as: making, open source, collaboration, co-design, open innovation, crowdsourcing, crowdfunding, open manufacturing, and many others, are very common in the literature on open design, to the point that some authors (Aitamurto, Holland & Hussain, 2015; Gasparotto, 2019) have identified this broader area with the expression: “open paradigm in design research” or “open paradigm in the field of design”.

Starting from these considerations, this paper aims to examine an extensive area of intervention that spans the boundary of open design and considers different approaches related to the concept of openness as part of a larger system. Moreover, the research seeks to discover which tools are used, how opening processes operate in the different phases of the design process and what skills and resources are required.

2 Methodology

The first step of the research consists in the identification of the open approaches applied in the design field through a review of the literature and the classification of case studies. We performed a quantitative study by examining the case studies collected in 38 research papers written between 2000 and 2019 on the subject of open design. From a list of 42 total case studies we choose to consider the 20 most often-cited (Appendix 1). Case studies cited more than once in the same article were counted as 1 and case studies describing opposite phenomena, such as for example, patenting or “authorial” design, were excluded.

Selected case studies were analyzed, using qualitative research methods, based on the following questions:

- How does the case study work?
- Why does it appear in the literature on open design?
- What form does it take?
- Which methodologies were applied in the case study?

In the second step of the research we examined the results and identified four main clusters that group together methodologies with common characteristics. Each cluster, also called “approach” in this research study, is described in written and visual form and seen in relation to the design process. Reference was made to Karl Aspelund’s design process (2014), split in the following stages: Inspiration – Ideation – Conceptualization – Exploration/Refinement – Definition/Modelling – Communication – Production. To synthetize and simplify the reading, the different stages of Aspelund’s design process have been grouped in this paper into three macro areas: Conceptualization, Refinement and Production (Figure 1).

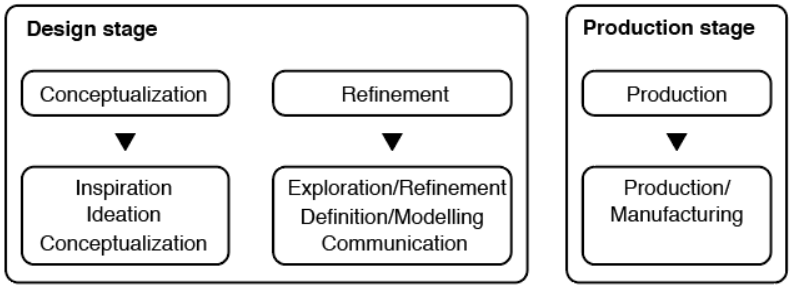

Figure 1. Synthetic representation of Aspelund's design process. Source: Silvia Gasparotto.

Finally, the last part of the research analyzed the “open paradigm” as a system by describing some case studies through a conceptual framework and by identifying the main attributes of each cluster.

3 The “open paradigm” in the design field

By examining Appendix 1 it may be observed that the selected case studies mostly involve web platforms, tools and software that use more than one methodology in the development of their projects. A more in-depth examination shows several similarities between the methodologies themselves. For example, considering common attributes and modes of operation, we noted that co-design and participatory design may be enclosed in a cluster that gathers many other samples of collaborative methodologies. For this reason, and for a simplified interpretation of the phenomenon, the research study proposes to collect and classify (Bailey, 1994) methodologies discovered in the analysis of case studies by gathering them into four subsets (Table 1): OS (Open source approach), CO (Collaborative approach), CR (Crowd approach), OM (Open manufacturing approach).

Table 1. The four clusters of the “open paradigm”.

Design phase			**Production phase**
OS	**CO**	**CR**	**OM**
Open design	Co - design	Crowdsourcing	Open manufacturing
Open source	Co - creation	Crowdfunding	Open distribution
Open hardware	Participatory design	Open innovation	Open production
Peer production	Design thinking	Decentralized innovation	Distributed manufacturing
	Co - development	Crowd production	Open fabrication
	Co - innovation	Crowd - creativity	Making
	User - creation	Crowd - innovation	DIY
	Community based development	Horizontal innovation	Personal or self - fabrication/production
	Meta - design		

3.1 OS – Open source approach

Open design, open source, open hardware and peer production are considered part of the OS cluster because of their relation to the open source approach. More specifically, the term open design began to appear in scientific literature around the 2000s (Vallance, Kiani & Nayfeh, 2001). Although its official definition is still open to new developments, the most acknowledged meaning of open design indicates those projects that follow the open source model by sharing all the information under a Creative Commons license (Balka, Raasch & Herstatt, 2010; Ciuccarelli, 2008; Van Abel, et al, 2011). Thanks to these agreements, all information related to the project may be used, edited and produced by anyone (Menichinelli, 2014). Open hardware and peer production are also related to the same approach; the first retrieves the dynamics of open source development for hardware, the second enables the creation of a product, a service or common goods by bringing together a self-organized community.

The practice of open source developed as a demonstration of dissent regarding the issues of intellectual property and democratic ethics; the values it expressed were then embraced by the open design philosophy, which expanded its goals to include: the desire to break down barriers between designer and user, the ability to design and manufacture unusual objects that often belong (as symbols) to specific communities, the freedom to design artefacts not limited or regulated by any authority. Other reasons to apply the open source approach in the design of physical objects reside in the advantage of creating a community of people who contribute to implementing a project. Sharing resources, in fact, facilitates the creation and experimentation of solutions to complex problems that may be very difficult to solve with limited human and economic resources (Murty, Paulini & Maher, 2010).

Finally, it should be specified that the OS approach has a horizontal dynamism. Although it is inevitable that a first person/group of people generates the "source project", the process does not develop in a top-down or bottom-up mode, but peer-to-peer. This dynamic, in fact, does not allow for any degree of control over subsequent versions of the project.

The case study most often cited for explaining the OS approach is Rep Rap, which is the first low cost and open source 3d printer built with both open software and open hardware. Another interesting case study to explain the dynamics of open source design is OpenStructures. In this case, the platform enables anyone to upload components designed on the basis of a specified grid – with predetermined dimensions – in order to allow holes and joints to fit together to create new and different open source objects, for example tables, chairs or lamps.

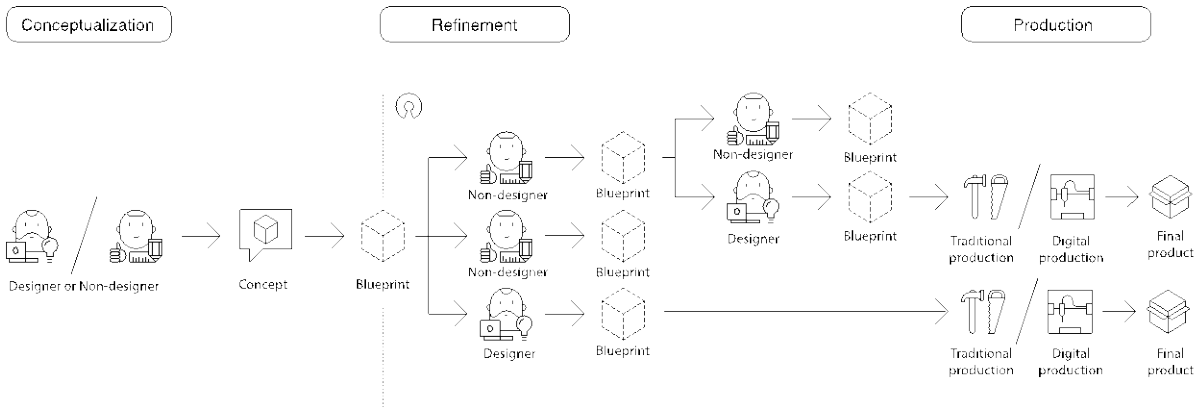

Figure 2. Visual representation of the OS approach. Source: Silvia Gasparotto.

The OS approach (Figure 2), can be started by anyone, designers or non-designers, using any sort of methodology. The process is opened up in the final stage of the conceptualization — when the source file is released as open source — as well as during the production phase (open manufacturing), so that everyone is given the opportunity to build the same artefact or its subsequent version by hand or with digital processing methods.

3.2 CO – Collaborative approach

In the cluster of CO, different methodologies related to the concept of collaboration coexist. The prerequisite of a CO approach lies in the belief that every individual is a bearer of knowledge and competencies that, when shared, will lead to a different – hopefully better – result than one that an individual could achieve alone (Sanders, 2008; Wilkinson & De Angeli, 2014).

There are many nuances that distinguish participatory design, co-design, meta-design, design thinking and the other collaborative methodologies, especially as they involve non-designers in different phases of the design process and in different roles. For example, in participatory design, non-designers are invited to collaborate in the early stages of the design process, but they don't make design decisions (Ehn & Bannon, 2012), whereas in meta-design, non-designers act as designers in a particular environment built by the designers themselves (Fischer & Scharff, 2000).

By analyzing case studies, the involvement of different people in this approach is relate to participation, especially for generating ideas and prototypes (Murphy & Hands, 2012). This involvement can be direct or mediated, open to all phases of the design process, or limited to only some of them. Traditionally within this methodology, the designer combines his classic role as a developer with the role of facilitator (Aguirre, Agudelo & Romm, 2017) within a group of people who work together to achieve a common goal.

The CO approach relies not only on the creative abilities of the individual, but seeks to use and enhance collective intelligence, imagination and skills that enable people to collaborate, to work and learn together (Levy & Bononno, 1997). Though traditionally, co-design methodologies are used in real communities and in different fields such as architecture, urban planning and, of course, design, most of the case studies gathered in this research paper regard online platforms. Collaborative tools used on platforms such as Quirky.com, OpenIdeo.com, Arduino.cc or GitHub.com are basic but effective. They include forums, chats and private mail-boxes useful to the community for communicating with one another. In analyzing the case studies, it becomes clear that the designer's traditional role as a

facilitator is not always required. This role is not so important for co-design online communities which seem to prefer a rougher rather than an effective qualitative result.

In the CO approach (Figure 3), the design process is shared: a group of people – it does not matter whether they are designers, non-designers or design researchers – collaborate to achieve common goals. The team does not necessarily work together through every phase of the design process: members might participate in a co-design process in just, for example, the conceptualization phase, or the refinement phase.

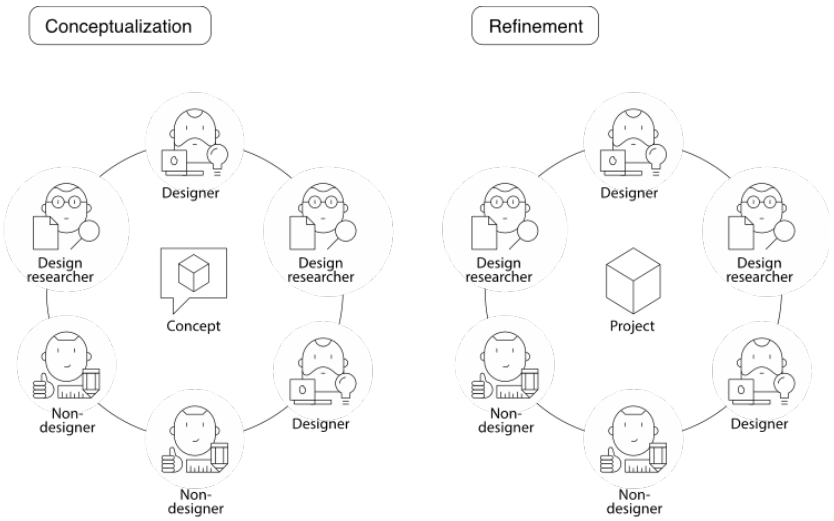

Figure 3. Visual representation of the CO approach. Source: Silvia Gasparotto.

3.3 CR – Crowd approach

The CR approach contains different crowd-related subjects, such as crowdsourcing, open innovation or crowd creativity. The common attribute of this subset is the open access to human, financial or creative resources usually related to innovation. Many different formulations have been used to explain this approach: crowd-based design activity, web-based collective design, or crowdsourcing for design (Hui, Greenberg & Gerber, 2014; Hajiamiri & Korkut, 2015; Xu & Bailey, 2011).

The term "crowd" combined with "sourcing" was first used by Jeff Howe in the magazine "Wired" (2006) and was further explored in the book titled “Crowdsourcing. The participatory value of the crowd as a resource for the future of work” (2008). In 2012, after comparing over forty definitions, Estellés-Arolas and González-Ladrón-de-Guevara of the University of Valencia perfected and expanded Howe's definition. They claimed that people usually respond to the "open call" of a crowdsourcing project to meet a real need, economic gain or social recognition, self-esteem, or developing a personal skill (Estellés-Arolas & De-Guevara, 2012).

Like CO, the CR approach also displays some differences between the methodologies grouped in the cluster. For example, crowdfunding is a collective funding method based on the accumulation of small amounts of money from many different investors. This system is used extensively by designers who want to propose their innovative products on platforms such as Kickstarter or Indiegogo. Open innovation, instead, “is the use of purposive inflows and outflows of knowledge to accelerate innovation.” (Chesbrough, Vanhaverbeke & West, 2006).

The crowd-based activities were made possible by the Internet, and many companies have added a virtual environment to their platforms, where everyone can gather ideas and make suggestions for new products or services (Bayus, 2013). It should be noted that the dynamics through which crowdsourcing in design is made manifest often combine competition and cooperation, so we cannot consider the crowd as just a collaborative community (Baek, Kim, Pahk & Manzini, 2017). Individuals participate in "challenges" or competitions focused on the same goal – for example proposing product innovations on the Quirky platform – from which in the end, however, only one person or a small number of participants will profit. Referring more specifically to the field of design study, the crowd is usually involved in the research and development of products that provide some sort of innovation. For this reason, in most cases competitiveness is equal or even more important than collaboration.

Online platforms that rely on this kind of process can deal with many different subjects: from product to visual communication, from video-making to services, all in search of solutions to problems. They respect a common procedure for the selection of ideas by adopting a competition format: the launch, the submission, the selection and the award ceremony. Examples of platforms that use the CR approach are the above-mentioned Quirky, but also Open Ideo, Zooppa and Javoto.

In the CR approach (Figure 4), in most cases the design process is developed by individuals, but the contest is the same for all participants.

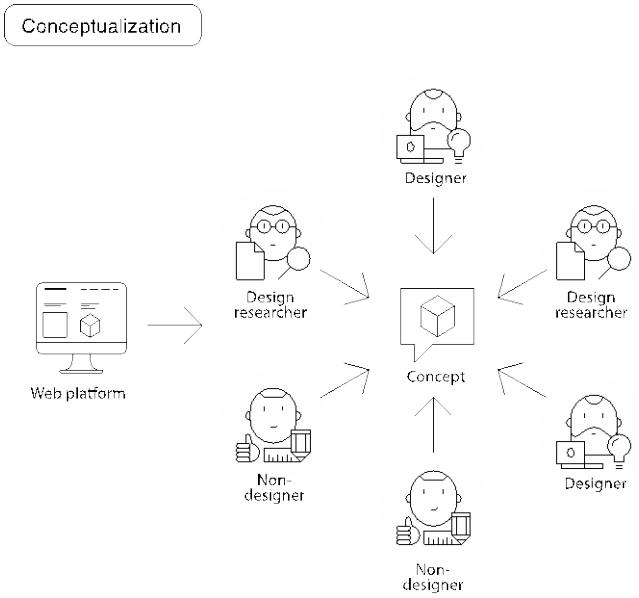

Figure 4. Visual representation of the crowd design CR approach. Source: Silvia Gasparotto.

3.4 OM – Open manufacturing approach

The last approach of the “open paradigm” (OM) refers to the opening of the production stage of the design process. Open manufacturing, distributed manufacture or more generally "opening of production" (Seravalli, 2014) therefore refer to a type of production that is no longer isolated in sites or districts with a high concentration of industries but is widespread and disseminated across the territory. This approach suggests that the production system is on the verge of a sea change, of a magnitude similar to the transformation of communication

systems since the 1970s, when the network shifted from a centralized to a decentralized model, and later to a distributed system (Baran, 1964).

This production structure can be represented, in the “open paradigm”, by Fab Labs, desktop manufacturing tools and micro-factories (Bianchini & Maffei, 2013). These labs are provided with digital and traditional manufacturing machines and tools used for experimenting, producing and prototyping objects (Figure 5). The advantage of that approach is to produce goods at zero distance and to facilitate synergies between global design projects and local economic development “[...] in which local economies operate as separate, adaptive units linked within ever-wider networks of exchange at the local, regional, or global level" (Manzini, 2015, p. 20).

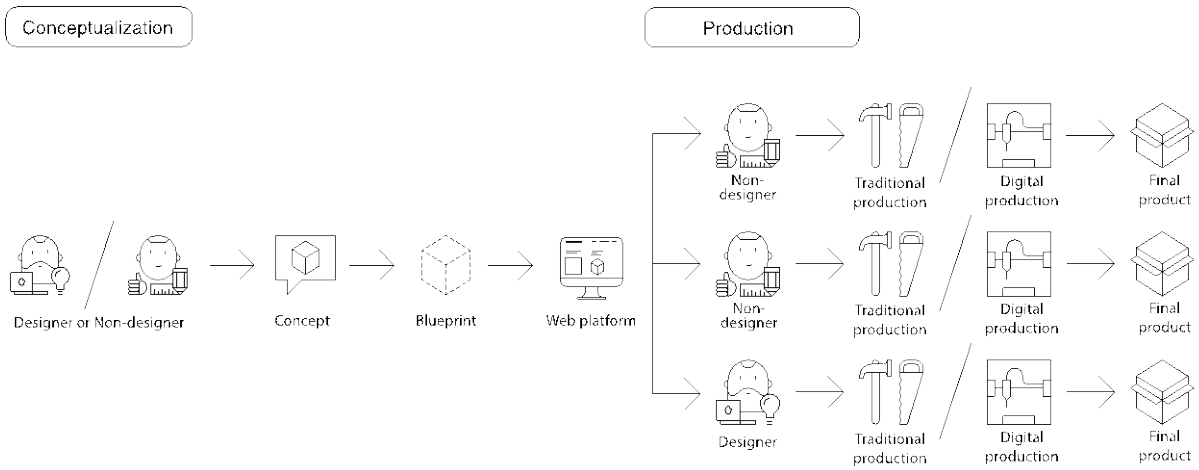

Figure 5. Visual representation of the OM approach. Source: Silvia Gasparotto.

Although open manufacturing is represented by examples such as Fab Labs and desktop manufacturing, it cannot yet be defined as a real production system. Most of the production machines and tools used in this approach are not yet sufficiently developed for mass production, in terms of manufacturing time and product quality, but in recent years research has made significant progress in the development of technologies. For example, Carbon has developed a 3d printer that uses a Continuous Liquid Interface Production (CLIP) process to produce 3d-printed objects faster and with a high level of quality in both the material and the finishing. The strength of Carbon’s machines is such that the company's payoff states: “Stop prototyping. Start producing.” Another company that uses the OM approach as a real production system is Open Desk, which designed furniture that can be downloaded as a blueprint and manufactured by CNC machines. Their platform also provides a global map where you can find the nearest Fab Lab.

The relative affordability and ease of access to these manufacturing machines opened a great debate in the design community, because in recent years it supported activities such as “making” and DIY (do it yourself), where the role of the designer is threatened by the possibility of opening the production phase to, potentially, everyone.

The term “maker” began to enter the lexicon of followers, and subsequently common parlance, after Dale Dougherty published a series of software guidelines in "Make" magazine in 2005, and after the publication that same year, in the same journal, of “The Maker's Bill of

Rights", which described the main aspects of the "Maker's" philosophy. The word "maker" does not allude to just a "social type", but speaks, in general, about a movement (Walter-Hermann, 2013). Commonly, the maker is someone who combines the skill of the craftsman with inventive thinking and the ability to use technology. His nature is more closely linked to the practice of making rather than designing, and the process through which the maker develops projects is usually by trial and error.

DIY is also a phenomenon related to the OM approach, but while "making" is mainly linked to digital production, DIY can also be related to traditional and craft production. Today, this practice has expanded thanks to the abundance of tutorials that may be found online, the so-called "instructional videos". A motivation that drives people to divulge their recipes and working methods may be found in their desire to share their skills with others. Some researchers, for example, recognize the as-yet unexplored potential for self-teaching inherent in this instrument (Hartley, 2012; Burgess & Green, 2009).

In design this phenomenon has created two different positions: one in favour and one against. The pro-DIY is summed up by Ellen Lupton (2006) in The DIY Debate: "By encouraging the public to use design tools intelligently, we will ultimately increase the general understanding of professional work, as well as raise the level of design across society". The opposite position is supported by Lawrie Heller in an interview granted to Lupton and published in the same book: assuming that everyone can be a designer through DIY diminishes the authority and respect for real designers.

The debate has not yet concluded and the issue regarding professionals and amateurs in the design field, which has been raised many times over the years (Kuznetsov & Paulos, 2010), will probably remain unresolved.

4 Analysis of the "open paradigm" in the design field

As suggested by Anderson in the manifesto "More is different" (Anderson, 1972), the description of a system changes if you look at it "brick by brick", or if you consider the entire wall, so in this chapter the four approaches of the "open paradigm" will be considered unitarily.

Firstly, it becomes clear that three of the four approaches in the "open paradigm" are related primarily to the design stage of the design process, whereas the fourth is associated with the production stage. Nevertheless, OS is considered fully accomplished when open source objects are produced with OM tools, whereas CO and CR can also be used with the traditional/closed mass production system.

This means that there is often an alternation between opening and closing both in the design and manufacturing stages (Table 2.). Of the four approaches, the one that seems to be more completely "open" is the OS one: the project becomes as fluid and widespread as its production. OM instead can be used as production or prototyping tools with a closed design stage as well (carried out by a single designer). CO and CR are always open in the design stage, but they can be closed in the manufacturing stage of the design process.

Table 2. Open and closed conditions in the design process.

	Conceptualization	Refinement	Manufacturing
OS	Open	Open	Open
CO	Open	Open	Open or closed
CR	Open	Open	Closed
OM	Open or closed	Open or closed	Open

Secondly, from the analysis of the case studies we can observe how, despite the pre-eminence of one process over the others, the dynamics are hybridized by using more than one approach for the development of the projects. For example, in the case of the Quirky platform, despite the predominance of CR, in many projects there are a series of CO sub-processes based on discussions in the chat rooms and private email boxes present in the platform. This tool makes it possible for the community to contribute in various ways to the development of the project (Figure 6).

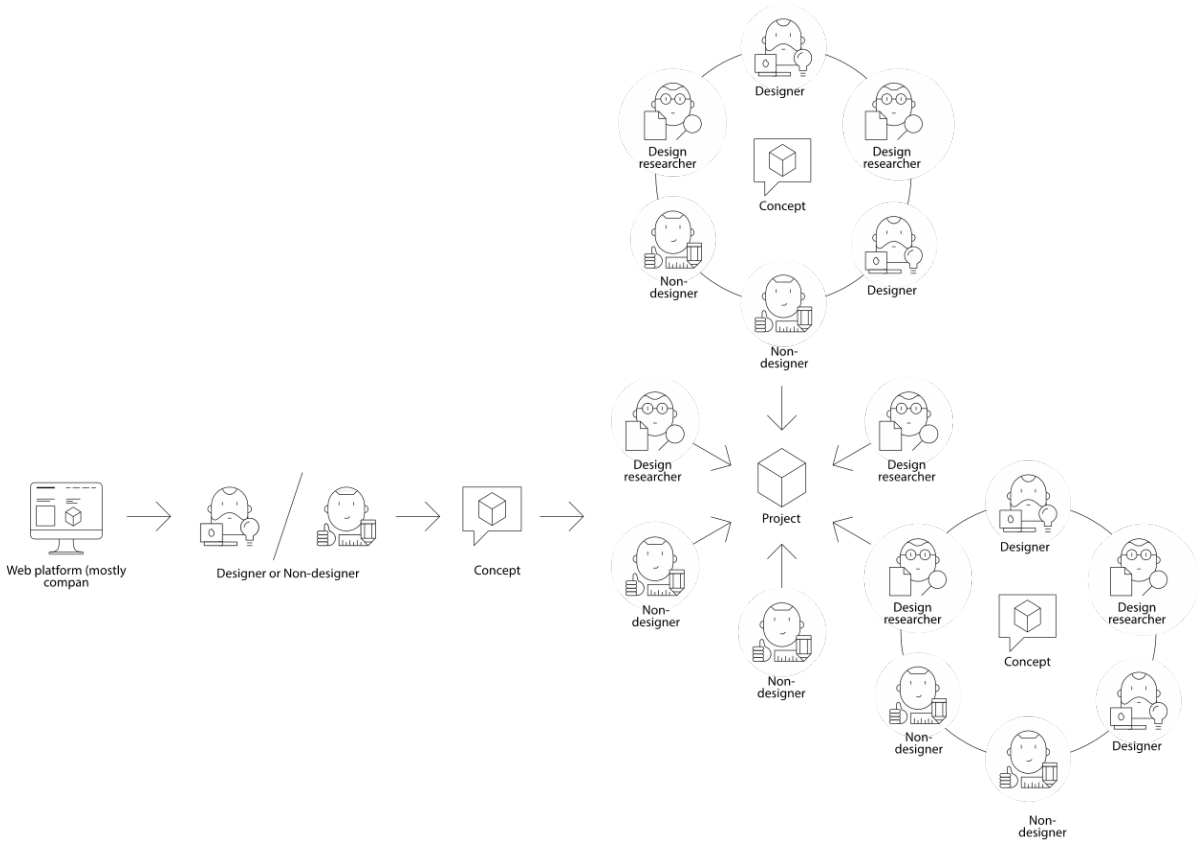

Figure 6. Approaches of openness used by Quirky. Source: Silvia Gasparotto.

A further example could be Thingiverse.com (Figure 7), where the OM approach achieved by 3d printing is complemented by OS and CO, because all files are under the Creative Commons license and because the platform provides tools such as the “remix” or “comment” buttons, to create different versions of the same original blueprint and to facilitate collaboration.

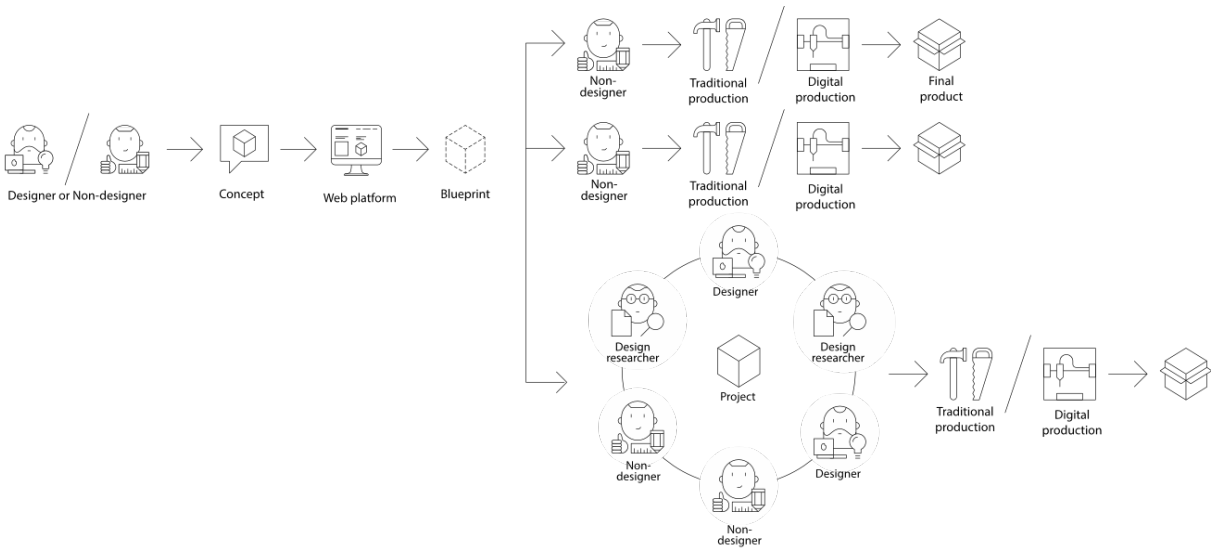

Figure 7. Approaches of openness used by Thingiverse. Source: Silvia Gasparotto.

The same combination may be seen in almost every case study collected by this research study (Table 3). For example, Rep-Rap is a mixture of OS, CO and OM and Open Ideo involves both CO and CR.

Table 3.

Case study	**"Open paradigm" approaches**
Rep Rap	OS + CO + OM
Arduino	OS + CO + OM
Fab Lab Network	OM + OS + CO
Instructables	OM + OS + CO
Openmoko	OS + OM + CO
Quirky	CR + CO
Thingiverse	OM + OS + CO
OpenIdeo	CR + CO
Innocentive	CR + CO
Linux	OS + CO
Local Motors	OS + OM + CO
Open Source Ecology	OS + OM + CO
Wiki House	OS + OM + CO
Autoprogettazione - Enzo Mari	OS + OM
Github	OS + OM + CO
Kickstarter	CR + CO
Open Structure	OS + OM + CO
Ponoko	OM
Shapeways	OM
Threadless	OM + CR + CO

Finally, for a unitary comprehension of the "open paradigm", it was useful to collect and synthetize some of the main attributes of each approach (Table 4) in order to understand which tools, resources and skills are used most, and how the designer behaves.

Table 4. Main attributes of the four approaches of the "open paradigm" in the design field.

	OD	**CO**	**CR**	**OM**
Dynamics	Use of the open source approach in the development of physical objects	Use of different methods of collaboration for developing projects.	Different methodologies that involve the crowd in design activities	The production of physical objects by a Fab Lab, desktop manufacturing or micro-factories
Tools	Computer with 3d/CAD programs, Fab Lab, 3d printers and other open manufacturing machines	Collaborative tools (mostly associated with an online platform) such as chats, forums, private mailboxes	Platforms that enable design challenges	3d printers, laser cutting, Fab Labs and other networked production tools
Resources	Web platform, Online communities	Web platform, Online communities	Web platform, Online communities	Different materials (eg. Plastic filament for 3d printer, wood, etc), and different production machines
Design skills	Sketching, three-dimensional modelling ability and CAD, prototyping, testing	Sketching, conceptualizing	Sketching, conceptualizing, modelling, CAD, prototyping, testing	Sketching, 3d modelling, CAD
Other skills	Programming	–	–	Use manufacturing machinery (both manually and digitally).
Design facilitation	Not required	Sometimes required, especially in real experiences	Not required	Sometimes required for helping to develop and prototype ideas.
Designer role	The designer could be the initiator of the project, but also one of the developers	The designer, when required can be the facilitator of a co-design process or he could be just a simple member of the group	The designer is usually one of the participants in the challenge, sometimes could also be the developer of another's idea	The designer helps with the development of the 3d/2d model and the production of the object or produces the object directly himself

In particular, it becomes clear that, although many design skills are necessary, the role of the designer is not always required. The established role of designers, non-designers and companies is blurred: in this area of intervention designers who voluntarily offer their skills, resources and projects, coexist with non-designers who possess particular design skills, inventors, engineers, makers and independent producers. This leads, especially in OS and OM, to the fabrication of many objects (Carelli, Bianchini & Arquilla, 2014) which sometimes have relevant functional and aesthetic attributes, but often seem to be nothing more than prototypes. The problem concerning the aesthetics of the product in the "open paradigm" is

of fundamental importance. Openness to non-designers and access to new digital production technologies facilitate free experimentation and prototyping that lead to results that are often precarious in both appearance and usability. Indeed, Vincenzo Cristallo (2015) stated that, in these areas, we have moved from the "aesthetic of beauty" to a new category, defined as the "aesthetics of experimentation" based on trial and error rather than on design culture. The role of the designer seems to diminish in importance in CO and CR as well: in the first case because the common dynamics of the different collaborative methodologies are not always applied in online platforms, preferring a more generic and spontaneous form of collaboration, and in the second case because to do his work, the designer must participate in a challenge with many others designer and non-designers, without the certainty that the project he developed will, in the end, be realized.

5 Conclusion

This research study was born from the necessity to better understand a comprehensive field, not yet fully detailed, that brings together openness and design. The very expression “open design”, which better qualifies this field, carries within it a variety of different meanings and related arguments.

Starting from the lack of agreement observed in both the literature and the case studies, the goal of this paper was to identify and define a broader area of intervention for design that can be called “open paradigm” in the field of design.

Dennett (2013, see introduction) argues that one of the most important “thinking tools” is the “scaffolding”: “You can shingle a roof, paint a house, or fix a chimney with the help of just a ladder, moving it and climbing, getting access to only a small part of the job at a time, but it’s often a lot easier in the end to take the time at the beginning to erect some sturdy staging that will allow you to move swiftly and safely around the whole project." This research study seeks to build the above-mentioned scaffolding – or categorization – from which to start exploring a field that is still “under construction”.

Following a review of the literature and the analysis of the case studies, four different approaches to openness have been found in both the design and the manufacturing stages: OS – Open source approach, CO – Collaborative approach, CR – crowd approach and OM – open manufacturing approach. These clusters are very different from each other and relate to different stages of the design process.

In identifying and describing the four different approaches of the “open paradigm”, the research has determined that the established way of doing design and the traditional role of the designer have changed in this particular field. Though the tools remain approximately the same, the “open” approach to design is not grounded in the design culture. This leads to a lack of planning and anticipation, an essential element for the design discipline. At the same time the role of the designer becomes marginal.

Although the design discipline has many obstacles to overcome, there are also many promising aspects to making the “open paradigm” a productive environment for developing innovative projects. For example, design should be able to connect different areas of knowledge, rework and synthesize new concepts, theories and discoveries, bring greater value to the design culture and finally create interdisciplinary networks that can meet the new tangible and intangible needs of people.

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Appendix 1

Case study	Rep	Website	Brief description[1]	Why is it cited in an open design paper?	What form does it take?	Which methodologies have been applied in the case study?
Rep Rap	13	www.reprap.org	"RepRap takes the form of a free desktop 3D printer capable of printing plastic objects. Since many parts of RepRap are made of plastic and RepRap prints those parts, RepRap self-replicates by making a kit of itself - a kit that anyone can assemble given time and materials."	Rep rap is the most cited case study in literature on open design. It uses the open source process for the development of replicable 3d printing.	Web Platform	Open design, Co-design, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Arduino	8	www.arduino.cc	"Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects."	Arduino is cited in the literature because it is an open source tool for prototyping open design objects.	Tool	Open design, co-design, co-creation, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Fab Lab Network	7	www.fablabs.io	"A Fab Lab is a technical prototyping platform for innovation and invention, providing stimulus for local entrepreneurship. A Fab Lab is also a platform for learning and innovation: a place to play, to create, to learn, to mentor, to invent."	The Fab Lab network provides manual and digital production tools for prototyping and manufacturing physical objects.	Set of tools	Open design, co-design, co-creation, open manufacturing, personal or self-fabrication, open distribution, DIY, open source, distributed manufacturing, open production, open hardware

[1] Descriptions are taken from the websites. All websites were last accessed on September 25, 2018

Instructables	5	www.instructables.com	"Instructables is a platform for you to share what you make through words, photos, video and files. From a one step recipe to a 100 step jet engine build, everyone has something to share. Join the biggest DIY community on the web."	Instructables is mostly cited because it is a platform for sharing DIY "recopies".	Web Platform	Open manufacturing, open design, Co-design, open distribution, DIY, personal or self-fabrication, distributed manufacturing, open production, open hardware peer production, meta-design, user-creation
Openmoko	5	www.openmoko.com	"Openmoko™ is a project dedicated to delivering mobile phones with an open source software stack. Openmoko was formerly associated with Openmoko Inc, but is now simply a gathering of people with the shared goal to "Free The Phone"."	Openmoko is an open source cell phone.	Web Platform	Open design, open manufacturing, open distribution, DIY, open source, distributed manufacturing, open production, open hardware
Quirky	5	www.quirky.com	"Quirky is a free community-led invention platform that brings real people’s ideas to life. Invention is hard. It requires a diverse set of skills, and it costs a lot of money. Everyday people have brilliant ideas but no way to see them become real products. Quirky makes inventing and selling products possible by pairing inventors with product designers and big manufacturing companies that can bring their ideas to life."	Quirky is a platform that enables open innovation on physical objects.	Web Platform	Co-design, co-creation, crowdsourcing, meta-design, design thinking, co-development, co-innovation, user-creation, community based development, crowd production, crowd-creativity, crowd-innovation, horizontal innovation

Thingiverse	5	www.thingiverse.com	"MakerBot's Thingiverse is a thriving design community for discovering, making, and sharing 3D printable things. As the world's largest 3D printing community, we believe that everyone should be encouraged to create and remix 3D things, no matter their technical expertise or previous experience."		Web Platform	Open design, co-design, co-creation, open manufacturing, open distribution DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
OpenIdeo	5	www.openideo.com	"Founded in 2010, OpenIDEO—IDEO's open innovation practice — enables people worldwide to come together and build solutions for today's toughest societal problems. Online and around the globe, OpenIDEO works with world-class partners to convene diverse communities that collectively develop ideas and accelerate social innovation. OpenIDEO's platform expands on the power of crowdsourcing, equipping participants with resources, connections, and design tools to create real impact."	OpenIdeo is an innovation platform that works on an important world challenge. It gives the community the possibility to participate and offer its contribution.	Web Platform	Co-design, co-creation, crowdsourcing, meta-design, design thinking, co-development, co-innovation, user-creation, community based development, crowd production, crowd-creativity, crowd-innovation, horizontal innovation
Innocentive	4	www.innocentive.com	"Distributed in a previously unsearchable crowd are insights, flashes of genius and ideas that would never have been evident from job applications, resumes or consulting brochures. InnoCentive provides the network, methodology, platform, and expert support needed for the innovative	InnoCentive is mostly cited because of its crowd based innovation system on high level challenges.	Web Platform	Crowdsourcing, co-development, co-innovation, user-creation, crowd production, crowd-creativity, crowd-innovation

			potential of this connected world to be fully realised."			
Linux	4	www.linux.org	"Linux is the best-known and most-used open source operating system."	Linux is the most famous open source software.	Software	Open design, open distribution, open source, peer production
Local Motors	4	www.localmotors.com	"Local Motors is a ground mobility company focused on shaping the future for the better. Founded in 2007 with a belief in open collaboration and co-creation, Local Motors began low volume vehicle manufacturing of open-source designs using multiple micro-factories."	Local Motors is a company that works with open source and crowdsource processes to improve and innovate the world of vehicles.	Web Platform	Open design, co-design, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Open Source Ecology	4	www.opensourceecology.org	"We’re developing open source industrial machines that can be made for a fraction of commercial costs, and sharing our designs online for free. The goal of Open Source Ecology is to create an open source economy – an efficient economy which increases innovation by open collaboration."	Open source ecology shares open source blueprints and instructions for building industrial machines	Web Platform	Open design, co-design, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production

Wiki House	4	www.wikihouse.cc	"WikiHouse is an open source project to reinvent the way we make homes. It is being developed by architects, designers, engineers, inventors, manufacturers and builders, collaborating to develop the best, simplest, most sustainable, high-performance building technologies, which anyone can use and improve."	Wikihouse shares open source blueprints and instructions to build affordable houses.	Web Platform	Open design, Co-design, participatory design, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Autoprogettazione - Enzo Mari	3	www.corraini.com/it/catalogo/scheda_libro/62/Autoprogettazione	"Autoprogettazione" was an exhibit and later a book written by Enzo Mari and edited in 1974. He gives anyone instructions for manufacturing and assembling simple wood furniture.	Autoprogettazione is one of the first open design and DIY experiments.	Book	Open design, open manufacturing, open distribution, DIY, personal or self-fabrication, open production
Github	3	www.github.com	"GitHub is a development platform inspired by the way you work. From open source to business, you can host and review code, manage projects, and build software alongside millions of other developers."	GitHub is a platform for sharing open source projects (both hardware and software) and tracing the "forking".	Web Platform	Open design, co-design, co-creation, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Kickstarter	3	www.kickstarter.com	"Kickstarter helps artists, musicians, filmmakers, designers, and other creators find the resources and support they need to make their ideas a reality. To date, tens of thousands of creative projects — big and small — have come to life with the support of the Kickstarter community."	Kickstarter is a crowdfunding platform.	Web Platform	Crowdfunding

Open Structure	3	www.openstructures.net	"The OS (OpenStructures) project explores the possibility of a modular construction model where everyone designs for everyone on the basis of one shared geometrical grid. It initiates a kind of collaborative Meccano to which everybody can contribute parts, components and structures."	Open structure is a platform that shares modular components, based on a grid, for the assembly of physical objects.	Web Platform	Open design, co-design, co-creation, open manufacturing, open distribution, DIY, personal or self-fabrication, open source, distributed manufacturing, open production, open hardware peer production
Ponoko	3	www.ponoko.com	"Ponoko provides laser cutting & engraving services to turn your designs into custom products. You select from 99+ beautiful materials, download our design template, add your design to it, then upload it to get an instant online quote to make your design real."	Ponoko is a service that enables the self-production (DYI) of objects thanks to rapid prototyping machines.	Web Platform	Open manufacturing, open distribution, DIY, personal or self-fabrication, distributed manufacturing, open production
Shapeways	3	www.shapeways.com	"Shapeways has set out to redefine product creation. It is a platform that enables the full creator experience through design, making, and selling--born out of its consumer 3D printing service, the largest in the world."	Shapeways is a platform for designing, manufacturing and selling 3d-printed objects.	Web Platform	Open manufacturing, open distribution, DIY, personal or self-fabrication, distributed manufacturing, open production
Threadless	3	www.threadless.com	"What started as a t-shirt company has since expanded into a full lineup of apparel, accessories, home decor, and now footwear canvases."	Threadless is one of the first companies to enable accessory customization.	Web Platform	Open manufacturing, open distribution, DIY, personal or self-fabrication, distributed manufacturing, open production

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A Study of Terracotta Warrior Proportions Based on Grid Division

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The so-called 'Terracotta Army' or 'Terracotta Warriors' is a collection of life-sized clay figures excavated in China in 1970s. The main function of this army was to guard the after-life of the first emperor of China. Archaeological evidence shows that the manufacture of the warriors involved a degree of mass production; therefore it is believed that various standards of proportions can be detected in the terracotta figures. It is well known that grid systems played an important role in dividing the human body geometrically to provide proportions. Application of square grid systems (or cannons of proportion) have been found in ancient Egyptian drawings, ancient Greek sculptures as well as Renaissance statues. This paper reports on the study of 35 of the terracotta standing human figures selected from the 'The Pit 1 excavation report', and explores a 15 grid proportion system which may have been used by ancient Chinese crafts people when producing Terracotta Warriors.

Keywords: grids, proportion, Terracotta Warriors

1 Introduction

The terracotta army was discovered in Xi'an, China in 1974 (Geddes, 1984, p.5). The site can be dated back to 247 B.C.E. (Liu, Pagán and Liu, 2011, p.353) and was constructed to guard the after-life of the first emperor of China.

It is well-known that two-dimensional grids were used as guidelines to solve layout problems in various spheres of design. It has been shown that square grids were used in ancient Egyptian paintings (Weingarten, 2000, p.104; Iversen, 1968, p.217), that they underlie ancient Greek sculptures (Weingarten, 2000, p.106) and were used also in Assyrian reliefs (Robins, 1990, p.117) to provide proportional reference points for parts of the human body. This paper reviews the common types of proportional systems used (generally square grids of given proportions), as well as how different types of system divided the human body differently. A 15-grid system was developed (based initially on the division of the body by three) in order to study the terracotta warrior standing figure proportions (as this was found to be the most convenient means of accommodating the figures examined).

Attention is focused first on providing background information and on giving an explanation of the sampling methods used for selecting the terracotta figures. Then common types of cannons used elsewhere, and how they provided proportional division of human figures, are

reviewed, followed by an explanation of the analytical methods used for the terracotta warrior study reported here.

2 Terracotta army's background information

This section provides a range of background information relating to the terracotta army including commentary on the source of data and the process of making terracotta warriors.

The so-called terracotta army was discovered in Lintong, a country district in the east of Xi'an, China in 1974 (Geddes, 1984, p.5). As noted in the introduction, the site can be dated back to 247 B.C.E. (Liu, Pagán and Liu, 2011, p.353) and was constructed to guard the after-life of the first emperor of China. Approximately 8,000 individual soldier-type clay figures, invariably referred to as 'warriors' (Geddes, 1984, p.5; Liu Pagán and Liu, 2011, p.352), 130 chariots and 670 horse figures (Liu Pagán and Liu, 2011, p.353) have been excavated so far, and this is believed to be only a small proportion of the total number of terracotta figures yet to be excavated (Liu Pagán and Liu , 2011, p.353).

From 1974 to 1976, three pits were found and numbered Pit 1, Pit 2 and Pit 3. These are located close to each other and occupy a total area of around 20,000 square metres (Zhao, 1988, p.1). The relative position of each (with a few further sites) is shown in Figure 1.

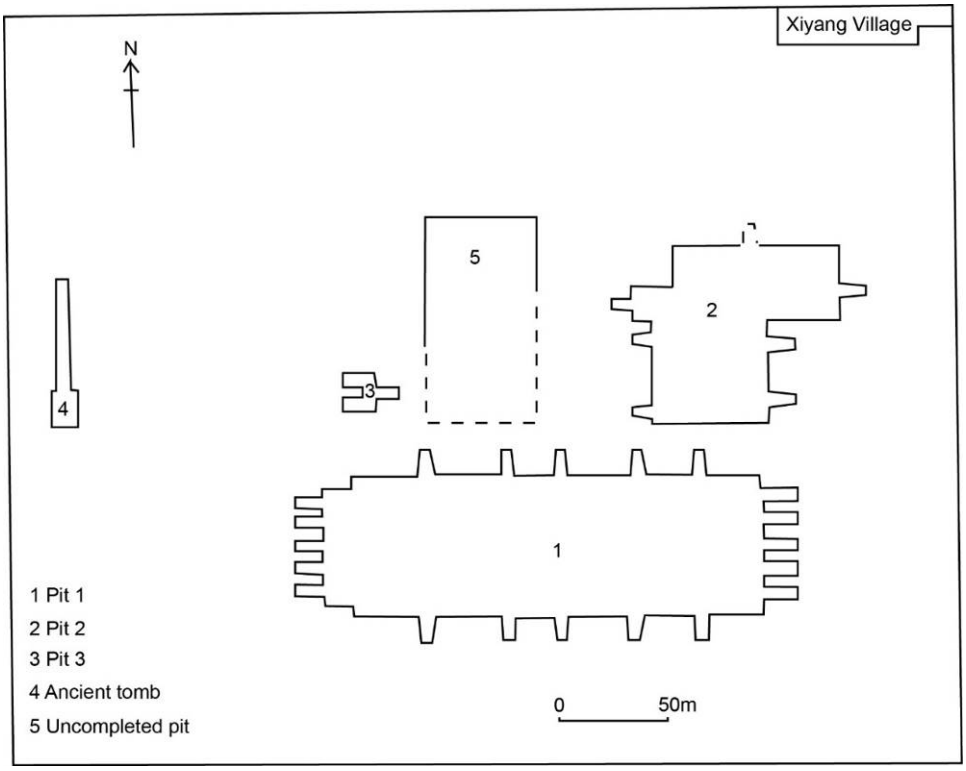


Figure 1. Positions of Pit 1, Pit 2 and Pit 3. Source: Re-drawn from Zhao, 1988, p.5.

The excavation of pit 1, (which occupies over 14,000 square metres) started in May 1978 (Zhao, 1988, p.1). The whole pit was divided into 27 squares (Figure 2). From 1979 to 1981, five squares against the east end of the pit were excavated. They are marked 1, 2, 10, 19 and 20, and illustrated in shaded form in Figure 2 (after, Zhao, 1988, p.9). Within these five sections, 1087 soldier figures (687 with armour and 400 without), 8 chariots and 32 horse figures were excavated (Zhao, 1988, p.10). By the year 1984, a further 28 terracotta (or pottery) horses and 714 warriors of different ranks had been uncovered (Zhao, 1988, p.10).

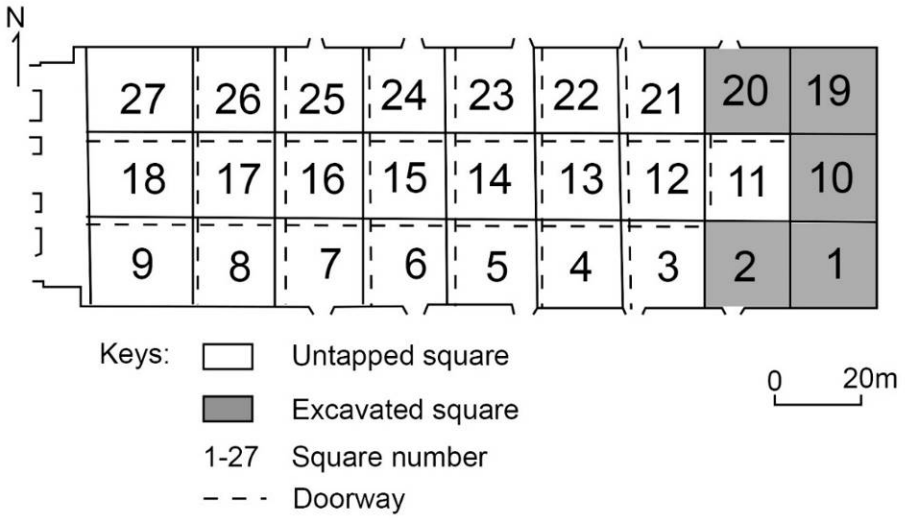


Figure 2. Locations of squares in pit 1 excavation. Source: Re-drawn from Zhao, 1988, p.10.

All illustrations of the figures and the measurements are based on the excavation report of the five squares (1, 2, 10, 19 and 20) in Pit 1.

The uniforms of soldiers and officers have no significant difference. The difference between the type of arms and ranks depend on the difference in the types of armour. Figure 3 shows the types of armour (Fu, 1985, p.10; Zhao, 1988, p.142).

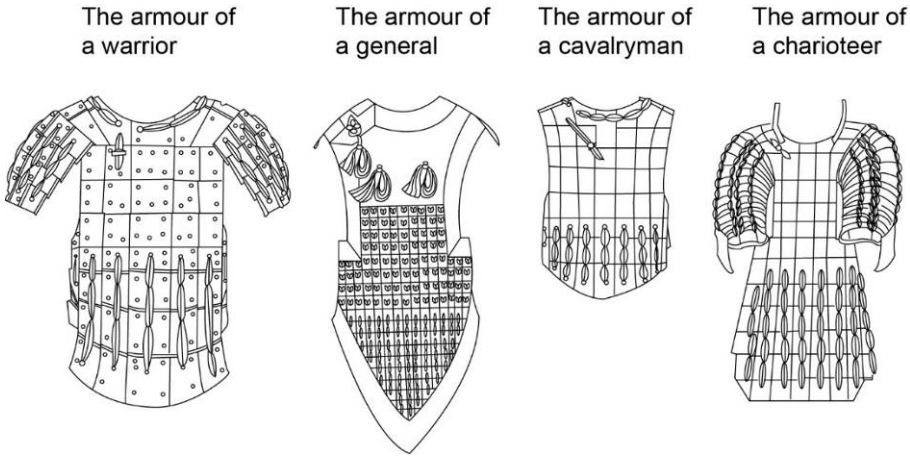


Figure 3. Types of armour. Source: Re-drawn from Fu, 1985, p.10.

Famously, each terracotta figure appears to be different and each may well be an individual portrait of an actual soldier (Portal, 2007, p.21) but this is not known with any certainty. However, to the contrary, archaeological evidence shows that the manufacture of the warriors involved a degree of mass production as a limited repertoire of body parts were found joined together in different combinations (Portal, 2007, p.21), with detailed work added by hand subsequently (Portal, 2007, p.21).

The heads and hands of the terracotta warriors were made separately, and then they were added to the torsos (Zhao, 1988, p.503). Similar to the body producing process, the rough shape of heads and hands were made with moulds first, and then individual details were sculptured on the top (Zhao, 1988, p.504). The variety of face shapes and the variety of

hand sizes and gestures suggests that there were several different types of moulds used to produce rough shapes during the manufacturing process (Zhao, 1988, p.499).

3 The selection of cases to be analysed

Robins mentioned that 'the whole figure must be preserved if it is to be used for grid analysis'; photographs have to 'be taken straight on without distortion'(Robins, 1990, p.108). Based on this view, 35 standing warrior figures illustrated in Zhao's 1988 report 'The Pits of Terracotta Warriors and Horses of Qin Shihuang Mausoleum - An Excavation of No. 1 Pit' (the Pit 1 excavation report) were selected.

Compared to the photographs presented in the report, the line illustrations of the warrior figures appeared to have less distortion. Also, it should be noted that only illustrations showing a front view were used. Kneeling figures were excluded from the study. So, using the Pit 1 excavation report as the source, all of the standing figure line illustrations, presented in the front view, were selected as samples for further proportion study.

4 Methods

Grid systems play an important role in dividing the human body geometrically since ancient times. Square grid systems (or cannons of proportion) have been found in ancient Egyptian drawings (Robins, 1994, p.73), ancient Greek sculptures (Weingarten, 2000, p.103) as well as Renaissance statues (Zenas, 1976). These grid systems allow for the standardization of proportions, and permit artists to place key points of the human body on particular grid lines in both horizontal and vertical directions. However, considerations relating to ideal human proportions appear to be different from culture to culture. This section reviews various modular grid systems from ancient to Italian Renaissance times.

It is believed that the first Egyptian cannon was a square grid system used before the 25th dynasty (early-7th century BCE) (Carter, Steinberg, 2010, p.104). With this system, male standing figures were divided into 18 equal parts vertically from the soles of their feet to their hairlines (Figure 4) (Robins, 1994, p.73; Weingarten, 2000, p.103). Key points of the body were marked by the horizontal division lines as follows:

Line 18: Hairline. Line 17: Through or near the bottom of the nose. Line 16: Through or near the junction of the neck and shoulder. Line 14: Through or near the nipple. Line 11: The navel. Line 9: Through or near the lower border of the buttocks. Line 6: Through the knees. Line 0: Below the soles of their feet. (Robins, 1994, p.73; Weingarten, 2000, p.103).

Other horizontal lines did not go through such obvious parts of the body (Robin, 1994, p.74). The vertical lines were drawn symmetrically parallel to the bisection line of the figure (Robins, 1994, p.74; Weingarten, 2000, p.103). Some key points can be defined also according to the position of the relationship between the lines and the body parts. For example, the shoulder width of the body was always six units wide (Robins, 1994, p.74); the width of the narrowest part of the waist was 2 1/4 to 2 1/2 squares (Robins, 1994, p.74).

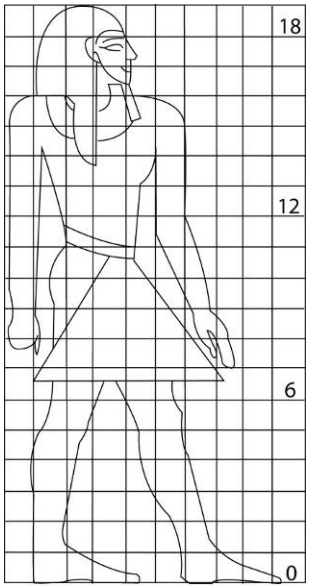


Figure 4. The first Egyptian cannon of proportion: the 18-square division.
Source: Re-drawn from Weingarten, 2000, p.104.

In the 26th dynasty (664-525 BCE) (Carter, Steinberg, 2010, p.104), the second Egyptian cannon replaced the first grid system to provide proportional divisions for human figure drawings. In this later system, male standing figures were divided into 21 equal parts from the sole of their feet to their upper eyelids (Figure 5) (Robins, 1994, p.160; Iversen, 1968, p.217). Key points of the body were divided by the horizontal lines as follows:

Line 21: Through the upper eyelid. Line 20: Through the mouth. Line 19: Through the junction of the neck and shoulder. Line 16: Through or near the nipple. Line 13: Through or near the small section of the back. Line 11: Through or near the lower border of the buttocks. Line 7: Top of the knees. Line 6: Below the bulge of the tibial tubercle. Line 0: Below the soles of their feet. (Robins, 1994, p.160).

A vertical line goes through the ear bisection of the body, and other vertical lines are displayed symmetrically on both sides of the line (Robins, 1994, p.160). The shoulder width is approximately 7 squares; the armpit width is 5 squares and the width of the narrowest part of the waist is 2 3/4 to 3 squares (Robins, 1994, p.163).The body features were, therefore placed between the grid lines rather than on the grid lines (Robins, 1994, p.160). For example, in Figure 5, the outer edges of the shoulder are placed between grid lines instead of placed on the grid lines. Likewise, the edge of upper arm and waist are in the middle of the grid cells.

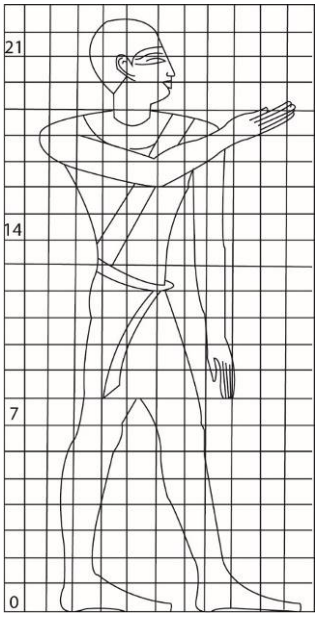


Figure 5. The second Egyptian cannon of proportion: the 21-grid division.
Source: Drawn from Iversen, 1968, p.217.

In the study of Korai (the largest Minoan statue) proportions, Guralink declared that the second Egyptian cannon of proportion was found in both male and female Korai figures, and thus argued that Greek sculptures adopted Egyptian cannon without major modification (Guralink, 1981, p.270). However, in a more recent study, Weingarten (2000, p.106) suggested a 21- grid for the Palaikastro Kouros statue. As can be seen in Figure 6, the 21 grid measurement was between the hairline and the sole of the feet. Using this system the key points of the statue were proposed as follows:

Line 21: The hairline. Line 18: The widest point of the shoulders. Line 17: The nipples and armpits. Line 11: Top of buttocks. Line 10: Joins of the legs or lower buttocks. Line 6: The top of the knees. Line 1: Ankles. Line 0: Below the soles of their feet. (Weingarten, 2000, p.105).

Furthermore, Weingarten drew the vertical lines on both sides of the middle line and discovered that the widest part of the shoulders occupied 3 units on each side, 'exactly as in the Egyptian cannon' (Weingarten, 2000, p.108).

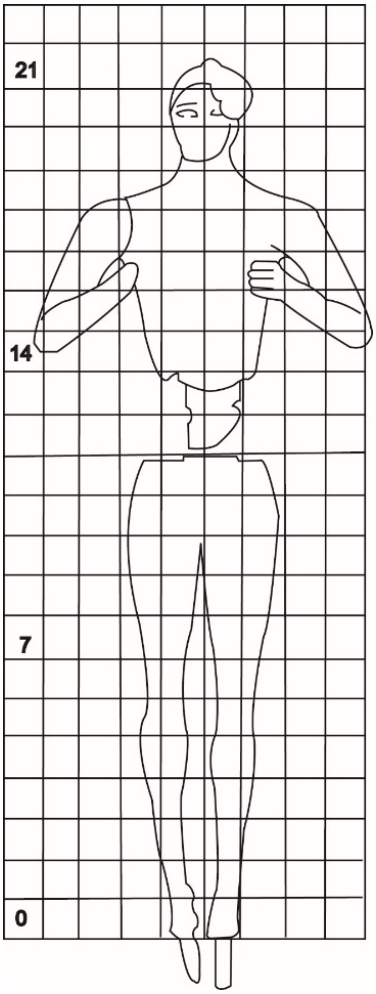


Figure 6. The 21-grid division for the Palaikastro Kouros statue, as proposed by Weingarten. Source: Drawn from Weingarten, 2000, p.106.

Robins set out to discover the proportions of Assyrian figures by applying a 15-grid system to the representations of 125 complete standing figures with human or eagle-headed features from North-west palace of Assurnasirpal II at Nimrud (Robins, 1990, p.107). This grid system divides each figure from the middle of their eyes to the bottom of the soles of their feet into 15 equal parts (Robins, 1990, p.108). Accordingly, the key points in the horizontal direction were found to be:

Line 15: The middle of the eye. Line 13: The forward shoulder (eagle-headed figure only). Line 9: Top of the buttocks. Line 5: The bottom of the kilt. Line 2: 1/2: The calf muscle. Line 0: Line 0: Below the soles. (Robins, 1990, p.109).

Vertically, the division spreads from the body axis like the Egyptian cannon. The width of the body at the buttocks is 3 squares (shown in Figure 7) (Robins, 1990, p.110). Robins also pointed out that although the heights of those Assyrian figures are not the same, the key points of the body are located in a fairly limited range (Robins, 1990, p.116).However, none of them is identical (Robins, 1990, p.116).

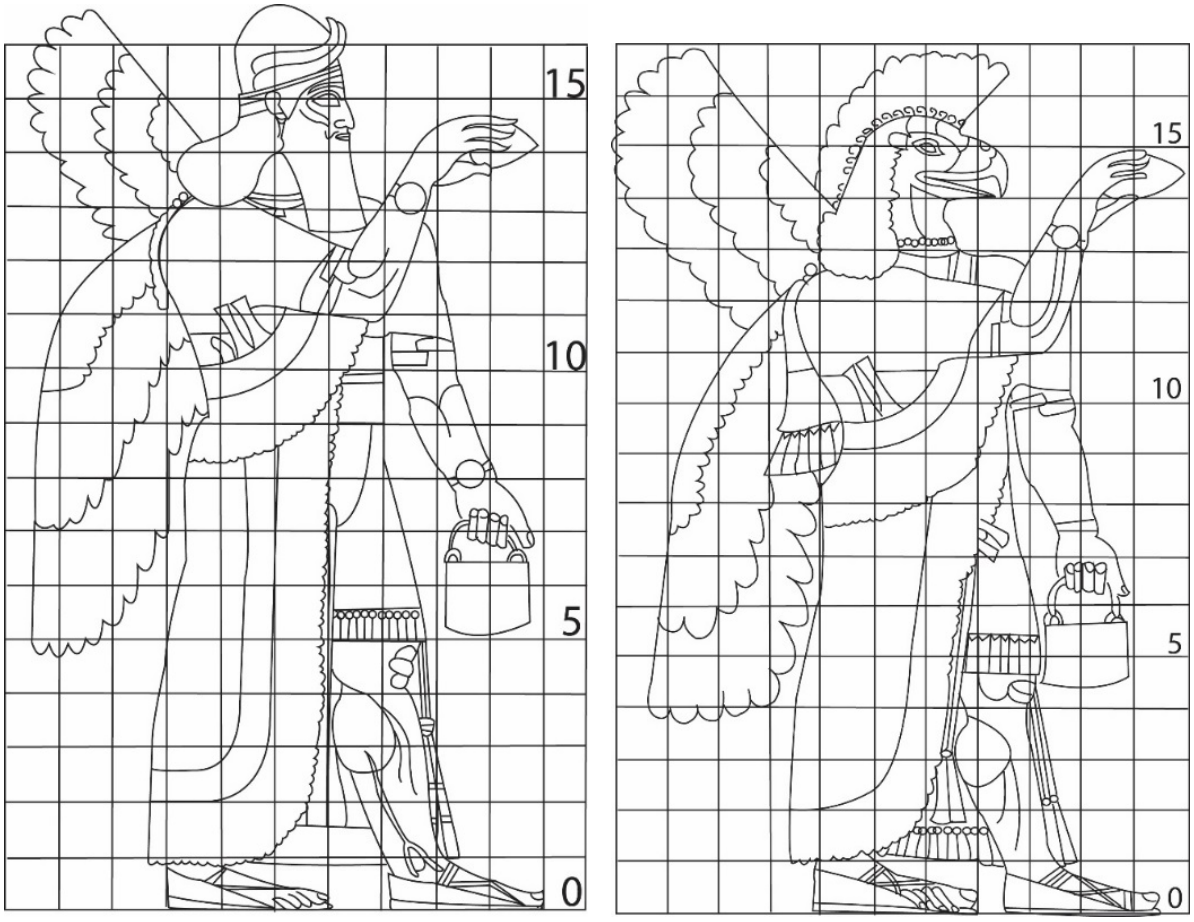


Figure 7. The 15-grid division in Assyrian human and eagle-headed figures.
Source: Drawn from Robins, 1990, p.117.

A proportional system known as ‘Cennini's cannon’ is a proportional division used in Italian Renaissance large-scale sculptures, which divided the human standing figure into 9 face lengths from the top of the head to the bottom of soles of their feet (Zervas, 1976). Evidence for such division was found in Ghiberti's St. Matthew (Figure 8a). The faces of the sculptures are divided into three equal parts. Cennini's cannon can be further interpreted into a 27-grid cannon (9 faces, each divided by 3) from the top of the head to the base of the soles. Figure 8b shows this case. Accordingly, the key points can be listed as follows:

Line 27: Top of the head. Line 22: Pit of the throat. Line 19: Middle of the chest (nipple). Line 16: Navel. Line 13: Thigh joint. Line 7: Knee. Line 0: Sole of the feet. (Zervas, 1976, p.37).

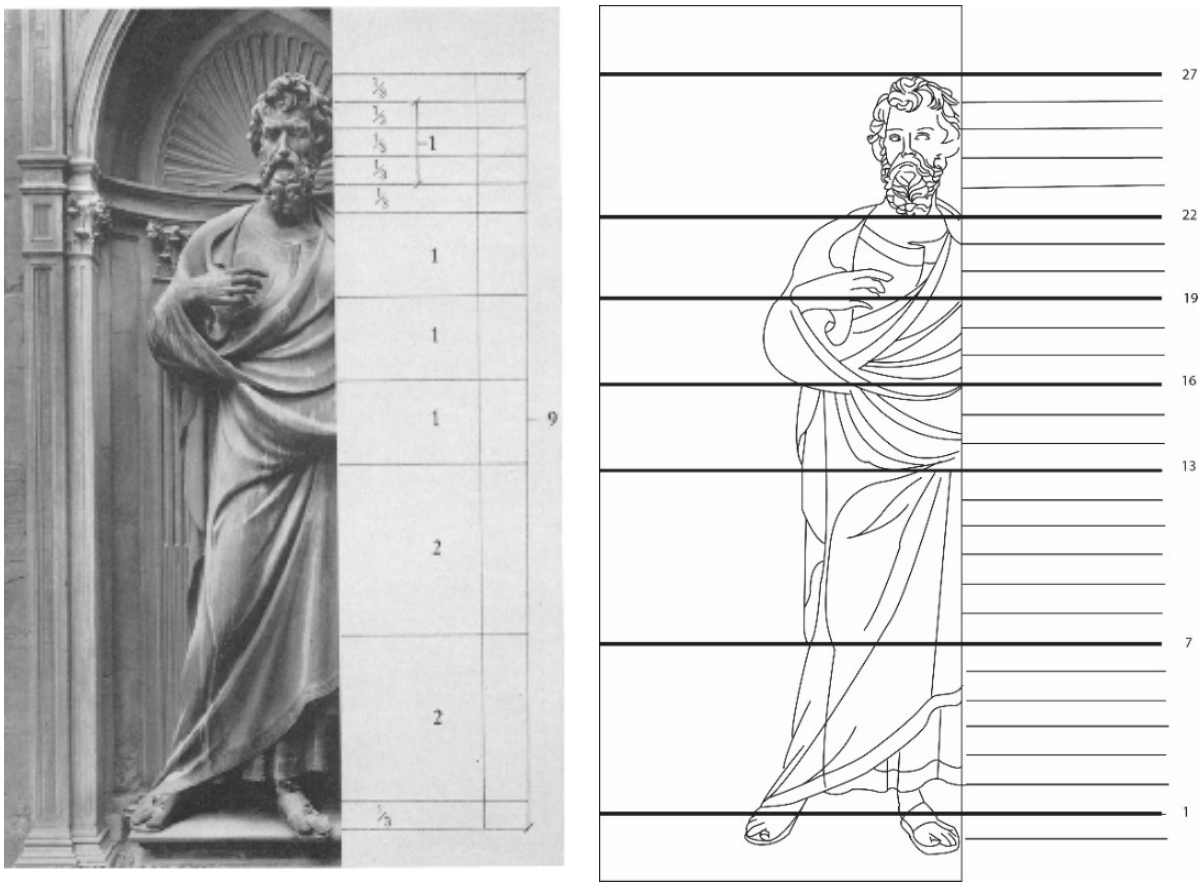
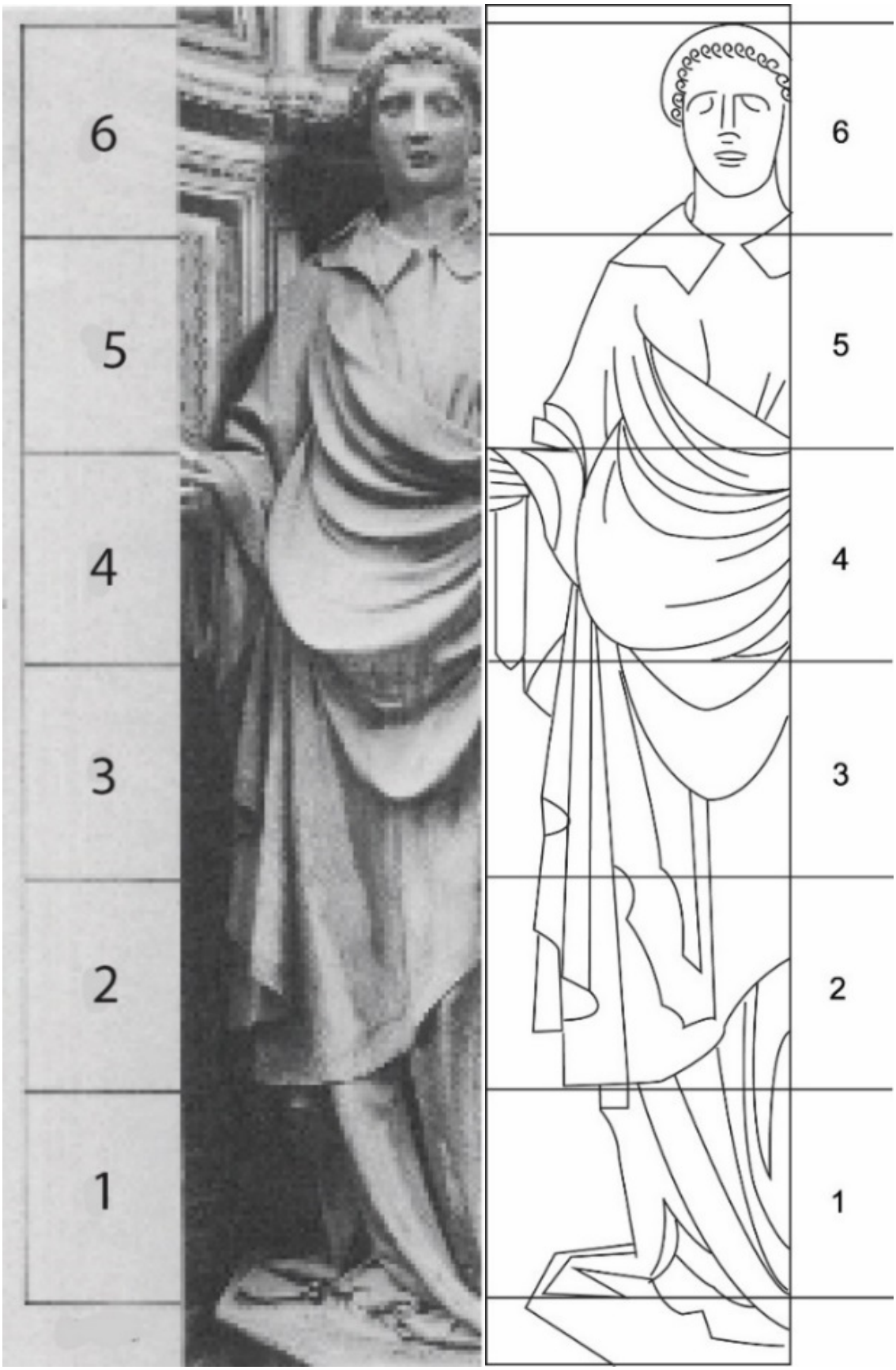


Figure 8. The Cennini's cannon division in large-scale Italian Renaissance sculptures.
Source: Drawn from Zervas, 1976, p.39; Morselli, 1978, p.236.

Alberti, an Italian Renaissance artist, divided the total human height as shown inFigures 9a and b (Morselli, 1978, p.238), a division that fits perfectly on the sculpture of St. Stephen (located in Florence, created by Ghiberti during 1427-28). The key points marked by each division line were: Line 6: The top of the head. Line 5: The shoulders. Line 4: At the lower edge of the sternum. Line 3: At the pubis. Line 2: Above the knee. Line 1: On the shin. Line 0: Sole of the foot. (Morselli, 1978, p.238).

Apart from cannon division, artists also tended to divide the human body by the length of certain body parts. For example, the height of the human body equals to eight head-lengths (Wolf, 1943, p.364); ten face-lengths (Fairbanks, 1988, p.76) or thirty-one nose-lengths (Fairbanks, 1988, p.76). Leonardo da Vinci also studied the proportional relationship between human body parts. He found out that 'four fingers make one palm and four palms make one foot' as well as 'the length of a man's outspread arm is equal to his height' (Creed, 1986, p.1541).

All the cannons mentioned above are based on multiples of 3. (For example, 27, 21, 18, 15 and 6). All the base lines are located at the bottom of soles of the feet. Only the top reference lines vary from the top of the head to the middle of the eyes.



a *b*

Figure 9. Alberti's 6 grids division on St. Stephen sculpture. Source: Drawn from Morselli, 1978, p.238.

Apart from the grid proportions, other methods relating to anthropometry has been proposed. For example, Le Corbusier divided the human body by using the 'modular' (Wittkower, 1960, p.212; Arnheim, 1955, p.48).He claimed that a standing male's height with raised arms can be divided into 2 equal parts at navel, meanwhile, the same division point (the naval) divides the human height without raised arms into a golden mean (Wittkower, 1960, p.212; Arnheim, 1955, p.48). Vitruvius' measured the human body by using the lengths of different body parts (Arnheim, 1955, p.51). For example, the total height of the human body can be measured by the length of 8 heads; 10 fces; 10 hands; 6 foot and 4 cubits (Arnheim, 1955, p.51). Furthermore, Tobin (1975, p.309) found √2 proportions exist in human body. He first declared that a √2 proportion exist in the length of the sections within the little figure sections, then the entire length of the little figure relates to the palm-wrist length in a √2 ratio. By multiplying this √2 ratio, he reached the length of forearm, the upper arm, head to clavicle, head to nipple, head to abdomen, groin, knee cap and the bottom of feet (Tobin, 1975, p.308-310).

The following section studies the proportion of Terracotta Warrior standing figures. The hypothesis is based on the literature reviewed.

5 Analysis and the development of a novel 15 square grid

Cannons of proportion (Weingarten, 2000, p.104) divide the human body into equal square grids according to a certain standardization of their natural proportions (Iversen 1968, p.215; Robins, 1994 p.23). This section explains the development of a suitable system of analysis and its application to two sample figures. After applying the common types of grid systems (explained previously) to the terracotta warrior figures, none of them showed a convincing relationship between the grid division lines and the key points of the body.

In the study of Assyrian standing figure proportions, Robins took the distance between the top of the knee and the bottom of the sole as a unit of measure, three units from the sole of the feet reached the middle of the eye (Robins, 1990, p.108). Then he sub-divided each unit into five equal grids. Therefore (as noted above and illustrated in Figure 7), the Assyrian figures were divided into 15 grid divisions from the middle level of their eyes to the bottom of their soles (Robins, 1990, p.108). With most terracotta warrior standing figures, most key points of the body were obscured by armour and robes worn, especially key points such as nipples, navel, and knees. Thus the method Robin used to define the upper reference point is not suitable in this study. Because most cannons can be divided by three, the division of three was used as a starting point of terracotta warrior proportional division.

Similar to all the cannons reviewed previously, the bottom of the soles of the feet was considered as a baseline, which is the lower reference point. After applying the division of three and various sub-divisions (5, 6, 7, and 9) between the baseline and various upper points (including the top of the head, hairline, upper eyelid and middle of the eye), it was observed that a 15-grid division between hairline and baseline makes more sense than other types of grids, as most horizontal division lines go through key points of the body. Thus, the bottom of the soles of each figure's feet was the lower reference point, while the hairline was considered as the upper reference point. The distance between the upper and lower reference points was divided into three equal sections, then each section was further divided into five equal parts. In other words, a 15-grid system from hairline to the bottom of the soles was chosen as the grid type most suitable to the study of terracotta warrior proportions.

Following the example given by Robins, measurements were calculated in square units, half squares and quarter squares (Robins, 1990, p.109).

6 The application of the proposed grid to the sample figures

Figure T1G2: 22 in Zhao, 1988, p.80 is one out of 35 warrior figures. The height from the soles of the feet to the top of the head measured 178 cm (Zhao, 1988, p.355). The distance between the soles and hairline is calculated as 172.25 cm. When a grid model of 11.48 cm square grid system is placed over the figure (Figure 10), the underlying structure marked by the horizontal grid lines can be listed as follows:

Line15: The hairline. Line 13: Through the junction of neck and shoulder. Line 11: Through or near the nipple. Line 9: Through or near the small section of the back. Line 4: Through the top of the knees. Line 0: Below the soles of the feet. Although the positions of the nipple and knee are obscured in the figure, Line 11 and line 4 still marked the approximate position of these two key points. Unlike Egyptian or Assyrian figures, this figure cannot be symmetrically divided in a vertical direction. The width of the body occupied 5 grid units, and the narrowest part of his waist took 3 and a half units.

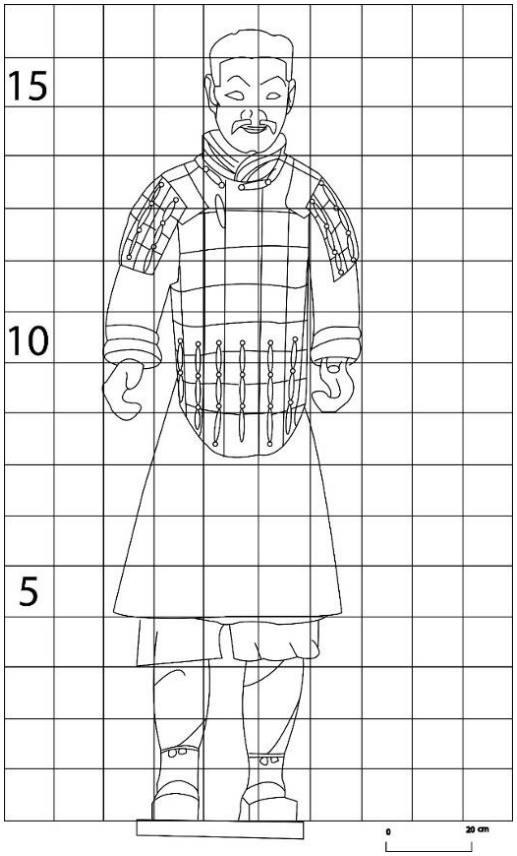


Figure 10. The application of the proposed grid to Figure T1G2: 22 from Zhao (1988).

When the same grid is applied to an unarmoured figure T10G7:10 in Zhao, 1988, p.70, the scale of the grid units are slightly smaller than the previous case (T1G2: 22), as the measurement of T10G7:10 from top of his head to the bottom of his sole is 176 cm (Zhao, 1988, p.364). The distance between his sole and hairline is calculated 170 cm; therefore the length of each grid unit is 11.35 cm. Figure 11 illustrates this case. The horizontal division lines mark the following key points:

Line15: The hairline. Line 13: Through the junction of neck and shoulder. Line 11: Through or near the nipple. Line 9: Through or near the small section of the back. Line 4: Through the top of the knees. Line 0: Below the soles of the feet.

In this case, line 11 and line 4 mark the position of the nipple and knee respectively, where these two points are obscured by the robe.

Horizontally, the figure occupies slightly less than 5 units, almost two and a half units on each side of the bisection line. The narrowest part of the body takes approximately two and a half units.

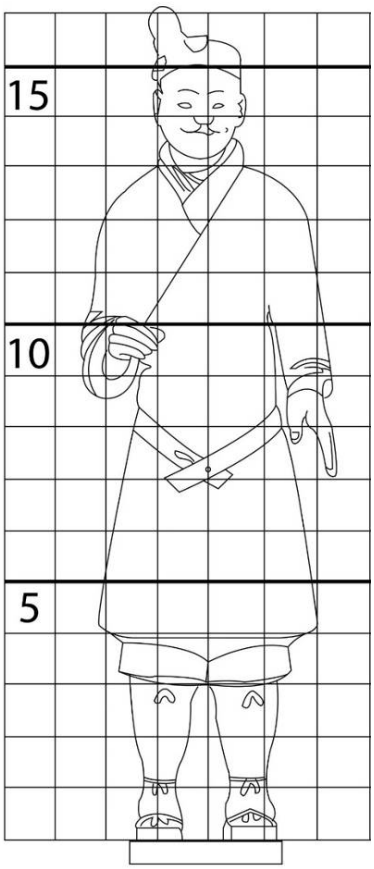


Figure 11. The application of the proposed grid to Figure T10G7: 10 from Zhao (1988).

7 Results

After applying the same division method and the proposed grids to 35 standing terracotta figures, the key points which are marked by the horizontal division line can be summarised as follows:

Line 15: marks the hairline in all cases. Line 13: through the junction of neck and shoulder or very close to the junction of neck and shoulder in 28 samples, 4 samples have this line half a unit below the junction of neck and shoulder, the other 3 sample figures have this line a quarter of a unit below the junction. Line 11: marks or gives a near position of nipples in 27 cases. Line 9: goes through the narrowest part of the waist in 33 out of 35 samples. Line 4: marks the top of knee in all samples. Line 0: as the baseline, was placed at the bottom of the feet in all cases.

The width of the sample figures varied from 4 to 6 units, among which three pieces were with a width of 6 units, one piece with 4 units, 16 with 5 or almost 5 units, and the other 15 figures with 5.5 units.

The detailed relationship between the key points and the grid division lines is listed in Table 1.

Table 1 Relationship between the key points and the proposed grid division lines

Serial number	Width (Units)	Line 15	Line 14	Line 13
T1G2				
8	5	Hairline	Bottom nose	Junction of neck and shoulder
22	5	Hairline		Junction of neck and shoulder
23	4.5	Hairline	Bottom nose	1/2 grid below the junction
39	5	Hairline	Bottom nose	Junction of neck and shoulder
T1G3				
6	almost 5	Hairline		Junction of neck and shoulder
7	5	Hairline		Junction of neck and shoulder
13	4.5	Hairline		Junction of neck and shoulder
T1K				
17	5	Hairline	Bottom nose	1/2 grid below the junction
72	4.5	Hairline	Bottom nose	Junction of neck and shoulder
74	5.5	Hairline		Close to junction of neck and shoulder
155	5	Hairline	Bottom nose	Junction of neck and shoulder
T2G2				
97	5.5	Hairline		Junction of neck and shoulder
T10G5				
3	5.25	Hairline		Junction of neck and shoulder
6	4.5	Hairline		Junction of neck and shoulder
12	6	Hairline		Close to junction of neck and shoulder
15	5.5	Hairline		1/4 grid above the junction
T10G6				
35	6	Hairline	Bottom nose	1/2 grid below the junction
T10G7				
10	almost 5	Hairline		Junction of neck and shoulder
T10K				
98	5	Hairline		Junction of neck and shoulder
105	5	Hairline	Bottom nose	Junction of neck and shoulder
111	5and a bit over	Hairline	Bottom nose	1/4 grid below the junction
T19G9				
2	5.25	Hairline		Close to junction of neck and shoulder
3	5	Hairline	Bottom nose	1/2 grid below the junction
16	almost 5	Hairline	Bottom nose	Close to junction of neck and shoulder
T19G10				
2	4.5	Hairline	Bottom nose	Junction of neck and shoulder
12	5	Hairline		1/4 grid below the junction
14	5.5	Hairline		Close to junction of neck and shoulder
17	5	Hairline	Bottom nose	Close to junction of neck and shoulder
24	almost 6	Hairline		Junction of neck and shoulder
25	5	Hairline	Bottom nose	Close to junction of neck and shoulder
31	5.5	Hairline		Junction of neck and shoulder
T19K				
139	4.5	Hairline		Junction of neck and shoulder
T20G9				
58	5	Hairline		Junction of neck and shoulder
T20G10				
88	almost 5	Hairline	Bottom nose	Junction of neck and shoulder
98	4	Hairline		Junction of neck and shoulder

Table 2 Relationship between the key points and the proposed grid division lines (continued)

Serial number		Line 11	Line 9	Line 8	Line 4	Line 0
T1G2						
8		Nipples		Small of the back	Top knee	Sole of the feet
22		Nipples	Small of the back		Top knee	Sole of the feet
23			Small of the back		Top knee	Sole of the feet
39		Nipples	Small of the back		Top knee	Sole of the feet
T1G3						
6		Nipples	Small of the back		Top knee	Sole of the feet
7		Nipples	Small of the back		Top knee	Sole of the feet
13		Nipples	Small of the back		Top knee	Sole of the feet
T1K						
17		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
72		Nipples	Small of the back	Top of belt	Top knee	Sole of the feet
74			Small of the back		Top knee	Sole of the feet
155		Nipples		Small of the back	Top knee	Sole of the feet
T2G2						
97		Nipples	Small of the back		Top knee	Sole of the feet
T10G5						
3		Nipples	Small of the back		Top knee	Sole of the feet
6		Nipples	Small of the back		Top knee	Sole of the feet
12			Small of the back		Top knee	Sole of the feet
15		Nipples	Small of the back		Top knee	Sole of the feet
T10G6						
35			Small of the back		Top knee	Sole of the feet
T10G7						
10		Nipples	Small of the back		Top knee	Sole of the feet
T10K						
98			Small of the back	Top of belt	Top knee	Sole of the feet
105		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
111		Nipples	Small of the back	Bottom of belt	Top knee	Sole of the feet
T19G9						
2		Nipples	Small of the back		Top knee	Sole of the feet
3			Small of the back		Top knee	Sole of the feet
16		Nipples	Small of the back		Top knee	Sole of the feet
T19G10						
2		Nipples	Small of the back		Top knee	Sole of the feet
12			Small of the back		Top knee	Sole of the feet
14		Nipples	Small of the back		Top knee	Sole of the feet
17			Small of the back		Top knee	Sole of the feet
24		Nipples	Small of the back		Top knee	Sole of the feet
25		Nipples	Small of the back		Top knee	Sole of the feet
31		Nipples	Small of the back		Top knee	Sole of the feet
T19K						
139		Nipples	Small of the back		Top knee	Sole of the feet
T20G9						
58		Nipples	Small of the back		Top knee	Sole of the feet
T20G10						
88		Nipples	Small of the back		Top knee	Sole of the feet
98		Nipples	Small of the back		Top knee	Sole of the feet

There is no evidence to show in this study that the grid unit size is based on the length (or width) of the nose, hands or other parts of the body.

Therefore, although there is no evidence that the ancient Chinese applied a particular cannon to provide a guideline for the proportions of human figures, the division of three and the use of a 15-grid system (shown here) indicate that some key body parts of the sample figures do fall on or are located close to certain grid lines, even though the heights and width of the sample figures are different. In other words, although no two identical proportions are found, the proposed division and grid system suggested that the ancient Chinese crafts people did follow certain proportion systems when producing terracotta warrior figures.

The reason that all of the figures were not lined exactly the same way may be due to the Terracotta Warrior production methods, which are a mix of mass production and detailed engraving. Archaeological evidence shows that several types of modules were used to produce rough shapes (Zhao, 1988, p.499). Furthermore, different details may be added on armour (4 types of armour mentioned in section 2), with the combination of different face shapes and sizes (Zhao, 1988, p.499), made it almost impossible to find 2 identical figures.

8 Conclusions

This paper firstly reviewed proportions in the human body in different measurement systems (including the proportions provided by grids and the proportions in anthropometry). Then a 15 grid system was developed, which may has been used as guidelines to govern the proportions of terracotta warrior standing figures. The hypothesis was based on the previous literature of square grids used in ancient Egyptian paintings, ancient Greek sculptures and Assyrian sculptures, each indicating proportional reference points for parts of the Terracotta figure. There is no evidence to show in this study that the grid unit size is based on the length (or width) of the nose, hands or other parts of the body.

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A Study of the Research Methods Used to Examine Design Patterns in Modern Chinese Architecture

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The design patterns of modern Chinese architecture have undergone frequent and complex changes within a short period. With one evolutionary trend alternating—and even crisscrossing—with another, any research on these trends is thus faced with certain difficulties. This study proposes a tripartite approach, namely, to focus on the local consciousness in the region under study, to combine historical views from the field of genealogy, and to draw on the classification of perspectives in social psychology, in order to examine research methods for modern Chinese architectural design in a novel fashion. The evolutionary path of the design patterns used in modern Chinese architecture is traced through a dynamically changing range of regions by studying the root cause for the formation of modern architecture's outward physical shape, and by adhering to the very phenomenon of architecture itself. In addition, the design patterns of modern Chinese architecture are classified based on the evolution of individuals, as well as of the communities' perceptions, emotions, and decision-making with regard to modern architecture, to approximate the in-depth cause of the formation of physical architectural forms and to shed light on the historical, artistic, and cultural significance of China's modern architecture.

Keywords: Modern Architecture; Design Pattern; Methodology; Classification

1 Introduction

In their clash with the rich tradition of Chinese architectural culture, flourishing colonial culture and western architecture styles have created a diverse range of styles and shapes in China's modern architecture. From about 1840 to 1949, China witnessed a vast number of architectural styles that leapfrogged through various stage of evolution. During this period, cultural exchanges of architectural styles also occurred, which influenced the different stages of development of region-specific architectural design patterns, including the self-protection and promotion of local architectural cultures, the social and psychological evolution, and the genealogical root and development of the architectural culture.

China's domestic research on modern architecture has made considerable progress, and the focus of the study is gradually transferring from the sorting of historical data and architectural styles to an in-depth, interdisciplinary analysis of the architectural culture to discover the historical, artistic, and humanistic value of architecture. However, the overall academic quality still demonstrates some room for improvement, which is mainly reflected in the

following three aspects. First, the majority of studies still focus on the architecture itself, and deeper analyses are needed. Second, the studies are often restricted in scope to one city and lack the idea of a region-wide system, which results in the absence of succession between discrete studies. The research on the evolution of China's modern architectural design has yet to form a cohesive system. Third, the scope is still narrow because the number of interdisciplinary studies is not enough.

First, China's modern architectural design patterns are not only influenced by western culture and Chinese traditions but are also closely linked to region-specific architectural culture. Therefore, simply examining one city alone is not sufficient to grasp the deep-seated cause of the evolution of architectural design patterns within the city. Efforts are needed to place architecture in the wider horizon of region-wide culture for analysis. Second, the evolution of architectural design patterns does not happen overnight, and there are often correlations that exist within the original design patterns. This genealogical study puts emphasis on details and pays attention to the coincidence of fragments (Michel Foucault, 2003), which are suitable attributes for a study on the origin and evolution of China's modern architectural design patterns. China's modern architecture has a long and complex history of colonial culture and is mixed with indigenous artistic styles, which fully demonstrates the rapidity of the drastic architectural changes of this period. Therefore, it is appropriate to dig deeper into the evolution of China's modern architecture designs by using ideas from genealogical studies. Thirdly, the evolution of architectural shapes depends on the development and propagation of culture, and the agents of cultural propagation are "human beings" and human psychological activities. Thus, the "human" influence on architectural forms opens up a gateway for studies to transform from uniform and stationary research on architectural shapes to dynamic research on the development of region-wide architectural forms. The dynamic overlapping and development of various architectural design patterns will be more clearly demonstrated through classification from the perspectives of social psychology and architectural taxonomy.

2 Research focusing on the local consciousness of the region under study

The passive nature of China's modern architecture, as it came into existence, has been widely recognized by Chinese academia. However, many politico-economic changes and developments take place within relatively small areas, and are not prevalent across the world (Wang Guobin, 2007). He claim that we should not only pay attention to the region and the outside world, but also the particularity of the region as a whole to focus on the internal factors of regional development. We should first acknowledge the existence of external factors and their significant impacts, but should also realize that their impacts do not absolutely exist in all times. This is the case seen in the self-protection, development, and breakthroughs of regional cultures when faced with stronger colonial cultures. Therefore, instead of focusing solely on the foreign cultures of colonists or the philosophical evolution of traditional Chinese ideology, studies on the design patterns of modern Chinese architecture should also pay attention to the evolution of regional cultures in the regions under study.

The significance of a region's localness does not reside in its size, but its homogeneity or heterogeneity. This has nothing to do with territorial integrity on the political level but is related to the amalgamation of similar activities in the cultural sense. In the case of China's modern architecture, the main regions include the coastal commercial areas in Southeast China, the region of business, politics, culture, and bureaucracy to the south of Yangtze

River, the region of business, politics, and military affairs around Beijing and Tianjin, the region of military and political affairs in the Northeast, and the more recently added south-central region of business, political/military affairs, and education. At present, relevant studies in the academic sphere mainly focus on the modern architecture of a certain city or buildings designed by a certain group of people. For example, in the case of coastal cities in the Southeast, the studies focus on colonial architecture, or modern architecture influenced by the culture of Hakka or overseas Chinese communities, rather than making deduction and comparison while considering the entire Southeast coastal commercial region. But at present, researchers mainly focus on Guangdong Province and Fujian Province, among which Guangzhou alone accounts for 41.9% of the research volume in Guangdong Province, and Xiamen in Fujian Province is also an important city, accounting for 64.3% (data source: Li Yinan, 2012). In fact, the commercial region along the Southeast coast is a traditional trading area, with active zones stretching from Fujian's Fuzhou in the north to Guangzhou in the south. Most of the port cities along the coastal line were opened during modern times, while the cultures of the Hakka and overseas Chinese merged with western architectural cultures in many cities to produce unique clusters of modern architecture. Therefore, when the focus of a study is expanded to incorporate the origin and development of modern architectural design along the entire southeastern coast, there should be an in-depth cultural analysis of the dynamic processes in which the local culture of this region accepted its overseas cultural cousins along with western culture. This is even more evident in the region south of the Yangtze River, which was the economic and cultural center of imperial China. With the ports opening as well as dual exposure to the impacts from the spheres of both new commercial forms and the political clout of the capital city, the long-standing local tradition of urbane and elegant styles took a hit, and an entirely new culture was born in the region during modern times. This region became synonymous with modernity and rapid development. A characteristic of this region during this phase is the joint development of politics, business, and culture, which is also the key to understand the different modern architectural styles of this region. Indeed, if a study focuses solely on Shanghai, the trend of western architecture does flourish there, but what is the reason for the appearance of such design patterns as the "grand roof"? This is inextricably linked with the "New Life" movement in Nanjing, the capital city at the time. At that time, Jiang Jieshi believed that while the Chinese people were accepting the new culture, they should not abandon the essence of the old culture (Zhang Chunxing, 2011).This shows that the influence of modern architecture on design patterns is not derived from a single unitary source, but rather from multiple complex ones. Additionally, although many accidental events may occur when a certain region's local culture and foreign ones are evenly matched while each has its merits, on the whole, the architecture will not spin away from the sphere of the region's local culture. Therefore, the development of a city's modern architecture is not only related to its background, but also to other cities within the homogeneous region in which this city resides. When the regional culture has a long history and abiding influence, the case could be more complex; thus, it is necessary to approach the study of modern architecture from the perspective of regional consciousness. However, there are more than one hundred Chinese literatures on the research of modern architecture in Shanghai now, while researches on modern architecture in Jiangnan as a whole region is in single digits (data resource: CNKI).

Moreover, the division of regions is not unalterable but varies along with changes in the spheres of regional culture. One sphere may merge with another one belonging to a homogenous culture, and may split off from a heterogeneous one; often, this does not

dovetail with the regional boundaries on maps. For example, the region of business, politics, and military affairs around Beijing and Tianjin coincided with the sphere of the capital city's political clout. After the fall of the Qing Dynasty, the capital was moved to the south, and its status in terms of political and military affairs diminished drastically. When it came to commerce and trade, the region also paled in comparison with Shanghai. Cities within the area underwent a period of slow growth, and thus, the region's sphere reduced sharply. With the local consciousness becoming more fragile, the region also lost its momentum, despite certain revival resulting from the planning and construction of foreign settlements in concession zones. Therefore, studies on modern architecture should not only pay attention to the region's local cultural background but also the boundary of activity of the region's cultural sphere, as this directly affects the source of cultural influence upon modern architecture, and in turn, plays a decisive role in the physical architectural forms of a period.

3 Research in combination with the historical views of genealogical studies

Traditionally, genealogy refers to studies on the lineage and names of families and emphasize the continuation and consistency of historical ties. Inspired by Nietzsche, Michel Foucault takes a stance that is critical of traditional historical views and proposes that history is composed of a series of fragmentary and intertwining contingent events. Foucault believes that the interpretation of those with the power of speech is not real "knowledge" or the origin of history, and advocates the intermittent method for historical studies to determine truth from within contingent episodes (Wu Qi, 2007). This approach to history, although echoed to some extent in studies on the design patterns of China's modern architecture, is the closest to reality. China's modern architecture underwent a history of successive regimes of political and military forces, which means that those in power changed frequently. This demonstrates how the holistic history on which architectural history is based is itself fragmentary, and the "knowledge" of modern architectural design is also complicated. This is the root cause of rapid development and many variations of design patterns within short periods.

China's modern history is fraught with fluctuations. The style of modern architecture also experienced intensive periods of drastic changes, and sometimes multiple currents of transformation occurred simultaneously. Being largely contingent happenstances, these changes bear full testimony to the Foucauldian idea of genealogy. Therefore, the introduction of genealogical perspectives on history is necessary for studying China's modern architecture. On the other hand, the abovementioned idea of focusing on regionalist characteristics is a precondition of and the limit range for genealogical perspectives on history. As the research methods of genealogical opinions usually tend to involve the drudgery of digging through ancient texts, it is necessary to have a limited range. Consequently, it is possible for studies on China's modern architecture to break free from comparisons of architectural forms (China's modern architectural design patterns are frequently compared with classical western design patterns, then classified and given category names. "Western classical style, feeling Baroque, imitation of the Spain style or the British Style (Pan Guxi, 2009), imitation of Gothic style castle, imitative collection of Eclecticism (Deng Qingtan, 2009), Eclecticism combining classical and modern Europe, imitation of Renaissance (Chen Congzhou and Zhang Ming (1990)" are the vocabularies used to describe these modern architectures.), and extend in more varied directions to stop being confined to the discrimination of visible material shapes, and to start inquiring after the very nature represented by the physical shapes. In other words, it has become imperative for

current studies to search for the origins of architectural design and the course of evolution of later-stage variations by following the developmental pattern of modern architecture.

There are two reasons for the adoption of genealogical perspectives on history for studying China's modern architecture. First, milestones of historical buildings reflect historical development and human needs. Traditional architecture higher up in the hierarchy of status puts more emphasis on the reverence and aspiration for the heavenly realm and has memorial significance exceeding the utilitarian value. Subsequent generations also tend to adopt the same rituals and ceremonies by following the model of their ancestors, leading to obvious phases and successions in the development and substitution of architectural designs. However, the emergence of China's modern architecture is not due to veneration for deities, but because of the more secular needs of the people. This was a period when different countries and social communities all exerted a conscious impact on architectural forms and design. Therefore, the emergence of China's modern architectural design patterns is a contingent but conscious mass event. Second, certain specific building materials and techniques are employed in traditional buildings, both of which are owned by the ruling classes. The emergence and development of China's modern architecture coincided with various political powers jostling for domination. With a thriving scene for the development of building materials and techniques, designers and builders had ample room for creation, and with the absence of uniform patterns and judgment standards, individual building owners had a comparatively larger say. As a result, modern architecture displays more of a personal touch during construction when compared to traditional buildings. In this sense, the birth of China's modern architectural patterns is an independent and unconscious contingent event. To summarize, given the complex and convoluted alterations in the birth of China's modern architectural design patterns, and because of the existence of the group and independent contingency traits, it is appropriate to combine the historical conceptions of genealogical studies.

4 Taxonomical studies in combination with perspectives of social psychology

Even with the recognition of regionalism and the adoption of historical views of genealogy, it is still daunting to conduct studies on China's modern architectural design patterns, and taxonomical studies are urgently required. The traditional means of classification in architectural studies is more suitable for the discovery and analysis of early research on China's modern architecture; a classification of corresponding architectural shapes based on a known timeline could leave some blurry areas. Therefore, it is less useful for the mid-to-later stages in discussions of the historical significance and cultural value of architecture. This is due to the frequent changes, multiple variations, and crisscrossing development of modern architectural design patterns within a short time, which calls for an improved means of taxonomy for more comprehensive analyses. As mentioned previously in this paper, the evolution of architectural design patterns is dependent on the development and propagation of cultures, and the main carriers of culture are human beings and their psychological activities. As Juliet L.H. Foster (2014) said, people who use public buildings may also influence the architectures. Changes of the buildings reflect the knowledge and understanding during the past time. Therefore, architectural patterns change along with the evolution of human psychological activities and the mindset of social communities during a building's time of construction could determine its pattern (Johann Joachim Winckelmann,1972; G.W.F Hegel, 1975); moreover, individual psychology manifests itself

throughout a certain type of architectural design pattern. Heinrich Wölfflin (1950) considered a style expresses an individual disposition, and also expresses an age and a nation. Consequently, the outward attributes of a building are closely connected to the psychological consciousness of social groups as well as individuals; the latter exerts a guiding and decisive effect upon the former, whereas the former serves as evidence of the latter's dynamic changes. This interactive relationship between the two is the fundamental factor in the overall dynamic development of modern architecture within a region. Juliet (2014) also hold that "social psychologists of knowledge might fine it helpful to explore architectural history in more depth." For this reason, it is necessary and inevitable to combine these two in architectural studies.

The psychological activities of human beings have implications for human decisions and strategies. "Human beings" are communal creatures. Tajfel, H. and Turner, J.C. (1986) found that individuals have some collective awareness of themselves as unique social entities and they tend to perceive and define themselves as a group. Therefore, it is necessary to pay attention both to the effects of evolution in individual psychology upon a single architectural pattern and to the self-classification and sense of identity of human beings within specific historical periods and against certain social backgrounds. The group to which one belongs and psychological changes in the group to which one mentally considers himself to belong are the main factors that influence the large-scale emergence of architectural shapes during a single period. When human beings are mentally and physically approached by an increasingly small margin, or already belong to a certain group, their individual thoughts and desires are assimilated into the will of the group (Rupert Brown, 2007); this uniform group will, on the other hand, is derived from individual thoughts and desires. Therefore, the two influence and change one another. During China's modern times, there was a quick succession of new ideas in economics, politics, and cultural spheres, in addition to the formation of new groups. Human beings, however, are also subject to the confines of the self, with the cultural context of their region exerting the most major and direct influence. The social psychology in different regions demonstrate diachronic similarities and synchronic differences; but the birth and development of China's modern architecture are, generally speaking, a process of the perception–acceptance–judgment–decision-making of the human beings native to a region, which is a process of passive psychological activities turning into active ones. Hence, a social psychological perspective will be widely applicable to the taxonomy of China's modern architecture.

To understand the influence of regional human psychology on China's modern architectural design patterns, it is possible to adopt the historical views of genealogical studies, and classify phenomena of modern architectural patterns that are already known in order to analyze the evolution as well as transformation of the perception, evaluation, and decision-making of individuals and social communities regarding modern architecture in a certain region. If the temporal development of the knowledge, emotions, and consciousness in the psychology of communities is considered the horizontal axis, and the temporal development of the knowledge, emotions, and consciousness in the psychology of individuals is taken as the vertical axis, a phasic curve can be formed demonstrating the different psychological understandings that a regional society has regarding China's modern architectural design patterns; thus, the major types of modern architectural design patterns can be classified. This is an ideal approach for combining the vast number of complex design patterns with the internal causes for their emergence, and to avoid the deviations resulting from comparisons between different architectural forms. Some early church buildings, for example, used indigenous materials and conformed to the native architectural culture. Afterward, with the

emergence of the idea of salvaging China from foreign subjugation, “grand roofs” became all the rage. In terms of architectural form, this design pattern belongs to the same category as some early church buildings; however, the cultural significance is categorically different. Therefore, the self-classification of a region’s modern architecture is possible by understanding the turning points in the social psychology of a region, and to recognize the correspondence between individual buildings or building clusters and the birth of individual consciousness, the emergence of class and group mentalities, and the growth of a national mindset. Such a taxonomical method is no longer limited to the time of construction or the visible architectural shape; rather, it is psychological anatomy of related characters (owner, architect, builder, etc.) and the groups they belong to, for the purpose of determining the type of a building. This approach illustrates the background, reason, and development of modern architectural design patterns, thus providing more clues to the exploration of in-depth historical significance and the cultural value of modern architecture design.

5 Conclusion

In conclusion, China’s modern architectural design went through drastic changes and multiple variations within a short period, due to architecture being at the forefront of the turbulent era of foreign invasion and domestic conflicts. Therefore, it is no longer appropriate to merely follow traditional research and classification methods; rather, a more interdisciplinary approach should be adopted based on the complex attributes of modern architecture itself. The target of a study should not be confined to a single building or a single city but should be extended to incorporate the wider dynamic changes of regional consciousness. Studies should pay close attention to the region boundary of influence, that is, the assimilation and divergence of boundaries. In addition, a lineage should be established in combination with developments in the multilateral relations in world and regional history; efforts should be made to go beyond a reliance upon the path of consistent historical development that is already known, and to adopt a regressive study considering the very phenomenon of the appearance of an architectural style during a certain period, thereby restoring from the phenomenon a comprehensive path of the architecture’s historical, artistic, and cultural evolution, and accentuating the contemporary significance of China’s modern architecture. Therefore, the focus of a study should not be limited to visible architectural forms, but should also include the dynamic evolutionary path of the social community and individual mindsets that affect the decision-making process for the shaping of architecture. By analyzing the interaction and transformation between individual and community mindsets, the evolution of recognition, evaluation, and decision-making regarding modern architecture within a certain region in modern times can be understood. On this basis, five major architectural types are proposed: forced recognition of self-change and sudden transformations, indiscriminate evaluation resulting from the bandwagon mentality and following suit in transformation, awareness of independent identity featuring succession and manifestation, active evaluation featuring activeness and development, and self-sufficient decisions featuring innovation and reconciliation. Such a classification prevents buildings with similar shapes but with completely different backgrounds of creation from being subsumed into the same category (which is seen in traditional classification methods), thereby making it more likely to better analyze the design patterns of modern architecture and to discover their deeper artistic and cultural value.

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A Study on the Visual Presentation of Humanized Devils in Illustration Design

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Different from angels, who have beautiful faces and wings to protect and guide the human being, images and the role of devils have not been clarified. Therefore, the conceptualization of devils is at the forefront of debate in terms of different fields. There are some studies related to theriomorphic (animal-form) devils and half human devils; however, a paucity of discussions are about humanized devils. This research intends to contribute to the imaginations of humanized devils. By using the illustration study as a medium to investigate key elements for people to recognize humanized devils, it also tries to enhance the effectiveness of communication between visual artists and the general audiences. Meanwhile, the research aims at improving the accuracy of the messages which are transferred from artists or designers to the audience in illustration works, providing a different perspectives to study humanized devils, and then using questionnaire survey as the methodology to study people's views and the messages people received from the illustrations. The research outcomes include the people's view about humanized devils, visual performances, and the analysis of the elements that influence the respondents' feelings related to humanized devils. The systematic visual information in this research study provides findings not only to researchers for further investigation in related fields, but also to visual artists and designers for sources of design references.

Keywords: Devil; Humanized devil; Illustration; Visual Art

1 Introduction

The interest in studying the devil began with a movie and the image of devils was not clear like the image of angels, which protect and guide human beings. There are so many different faces and characters for devils in different films. This interesting conflict attracted to study the image of the 'actual' devils. One of the findings in the literature review was about the devil work of temptation, according to Daniel (1964), two recorded stories of temptation were the trails of Gautama and the temptation of St. Anthony. Hence, this study will focus on the images related to devil's temptation.

In terms of the study of devils' images, Gettings (1988) describes that there are thoroughly humanized devils, theriomorphic (animal-form) devils and half human devils in the dictionary of demons, which was a guide to demons and demonologist in occult lore. The sort of devils can also be found in art and design history. For example, the theriomorphic devil was found

in the engraving of *The Fall of Man* (Adam and Eve) as figure 1, Adam and Eve lived happily in the Garden of Eden, and God warned them not to eat the fruit of the tree of wisdom; nonetheless, Adam and Eve still fall into the temptation from the serpent, which changed from Satan. Eve persuaded Adam to eat the forbidden fruit of the tree of wisdom, which angered God and drove Adam and Eve out of the Garden of Eden.

Figure 1. The Fall of Man (Adam and Eve).

Source: Retrieved Jan 29, 2019 from

https://www.themorgan.org/drawings/item/264931

Figure 2. Woman and devil embrace (Kwan, 2012)

Then, the half human devil was found in the illustration named woman and devil embrace as figure 2, from *De lamiis et pythonicis mulieribus*, which was the first illustrated witchcraft treatise written by Ulrich Molitor in 1489 and commissioned by Archduke Sigismund of Austria. Kwan (2012) mentioned ‘There remains an element of the bestial in the disguised devil: he has clawed or hoofed feet, sometimes a tail or sharp teeth. These reveal the hidden, inhuman nature of the devil—and although he had powers to trick and seduce, the discerning eye could nevertheless recognize him.’

The humanized devil found in the illustration named *How a devil in woman’s likeness* would have tempted Sir Bors from the book of Le Morte d'Arthur and looked like a beautiful woman with long hair as figure 3.This illustration described a group of sexy and seductive girls in revealing dresses standing on top of a castle tower gawking, and Sir Bors’ sword and shield lost their function in front of the devil and fell to the side of Sir Bors. Hsu (2006) thinks the woman with dark hair on the castle was a devil, and she was tempting Sir Bors with her beauty, but Sir Bors did not fall into her temptation. Compared three type of devils, the humanize devil was very difficult to identify; hence, it is worth studying and it would be the research focus.

Figure 3. How a devil in woman's likeness would have tempted Sir Bors (Malory, 1972)

Base on the treatise review, metaphor seem to be a popular approach to present the stories in the illustrations. However, it might be difficult to receive the original messages from the illustrator. An example was found in the illustration from De lamiis named *Witch laming a man* as shown in figure 4, Maxwell-Stuart (2001) claims that 'the image of the woman pointing an arrow at a man's bare foot has connotations of love magic and of witchcraft as an attack on male virility, as both the foot and the arrow had phallic connotations. Kwan (2012) in De lamiis about 'witches causing harm, and in the woodcut, the man has been injured by unnatural means, since the arrow is strung in reverse.' This sample picture shows that the messages send out from the artists might different from what the audience have interpreted.

Figure 4. Witch laming a man. *(Kwan, 2012)*

The main purposes are constructed as research questions by questionnaire survey. First of all, investigating people's views about devils in general to discover if the respondents like, dislike or have no feeling about humanized devil, and then to study what was the reason of it. Secondly, studying respondents' feelings about humanized devils in sample pictures, collecting the information about characters which the responders think he or she was devil and describing the feeling with an adjective. Thirdly, exploring the visual performance of

humanized devils in sample pictures, and analysis the elements that influence people to recognize devils. Finally, the research will provide visual resources and reference to illustrators, visual artists and researchers for future creation and studies.

2 Research purposes and questions - a visual study with Questionnaire Survey about people's view and devil's characters in the images of devils

In order to reduce the gap between artists and audiences, the study aims at exploring how the images affect the view of people about humanized devils, and then enhancing the communicate effectiveness by the images. People's admiration of illustrations or art pieces is a complex process which include a collaboration between the artists, images and the audiences. However, artists pay more attention on the messages they send out by the work based on their professional knowledge and experiences, which audience may not be concerned about. In order to solve this problem, this research adopts an audience-centered approach, which is based on audience-response criticism and emphasises the individual as the audience-responder. Because of various past experiences, thoughts and feelings people might have different views on the same images. Hence, this visual research targets to understand more about their views related to humanized devils. The study starts with questionnaire survey about devil's characters and people views based on the sample images of humanized devils, and then it will collect the visual elements and descriptions from audiences. At the end, the study provides ideas and design resources to artists on how to communicate with audiences in related topics. Meanwhile, it is also a valuable reference to researchers for their future related studies.

2.1 Methodology -- Questionnaire Survey

Phase 1 – The Establishment of the devil conceptual framework-- Sample Collection and Selection

Table 1. Sample Collection and Selection

Step	Processes
1	A team of six experts is invited in the field of fine art and illustration.
2	All experts designate the selection criteria which include black and white printmaking or illustration. The theme is about humanized devil in the story of temptation, so the style should be similar with sample picture which provided by the researcher.
3	Each expert presents two representative illustration or printmaking.
4	All experts select five samples based on the criteria after removing the same and similar samples.

The story background and the analysis of body language and facial expression in five final sample pictures:

1. Story background —*The lady of the lake telleth Arthur of the sword Excalibur* by Aubrey Beardsley as figure 5, the story is about for the sake of obtaining the Excalibur, King Arthur to the place where the lady of the lake was located, who was evil witch.

2. Story background —*The Temptation of the Idler by Albrecht Dürer* as figure 6, the picture illustrates a slothful man who sleeps in front of his heated fireplace,

comfortably resting his head against a soft pillow. According to medieval codes of conduct, such behaviour encouraged temptation, which is represented by the Devil, a demon who "blows" thoughts, which are presumably evil, into the sleeper's ear. Probably the dream itself is represented by the nude Venus, voluptuous and inviting.

3. Story background—*The witch Maiden saw the young man under a tree* by Henry Justice Ford as figure 7, which tells a story about the young man who has to seek help from the Witch-maiden, who knows where the ring he wants, the pictures described Witch-maiden come out of the forest, and tempts the youth by her beauty and asks him to spend the night with her.

4. Story background — *How Morgan Le Fay gave a shield to Sir Tristram* by Aubrey Beardsley as figure 8, which tells a story of King Arthur, Morgan was the daughter of King Arthur's wife and she was an evil witch. In the illustration, Morgan was tempting Sir Tristram to betray King Arthur; therefore, she gave a shield to him, but Tristram's expression is full of doubts and seems to be against Morgan, in case that she will make terrible acts.

5. Story background— *Faust's pact with Mephisto* by Julius Nisle as figure 9, Faust is the central character of the archetypal story of a deal with the devil, Faust signs a pact which is an evil agreement to seal their fate with Mephisto, and they handshaked after signing.

Figure 5. Sample 1. The Lady of The Lake Telleth Arthur of the Sword Excalibur by Aubrey Beardsley. (Beardsley, Symons & Harris, 1967)

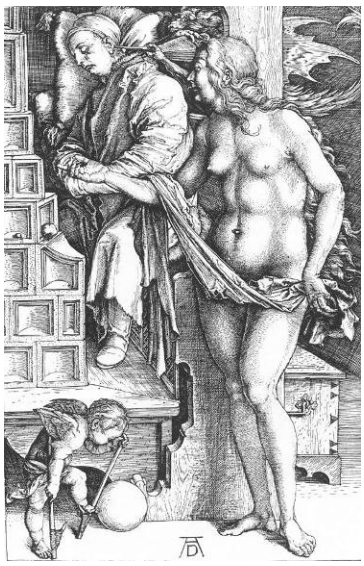


Figure 6. Sample 2. The Temptation of the Idler by Albrecht Dürer. Source: Retrieved Jan 29, 2019 from https://www.wga.hu/html_m/d/durer/2/13/1/022.html

Figure 7. Sample 3. The Witch Maiden Sees the Young Man Under a Tree by Henry Justice Ford. Source: Retrieved Jan 29, 2019 from http://www.victorianweb.org/art/illustration/ford/9.html

Figure 8. Sample 4. How Morgan Le Fay Gave a Shield to Sir Tristram by Aubrey Beardsley. (Malory, 1972)

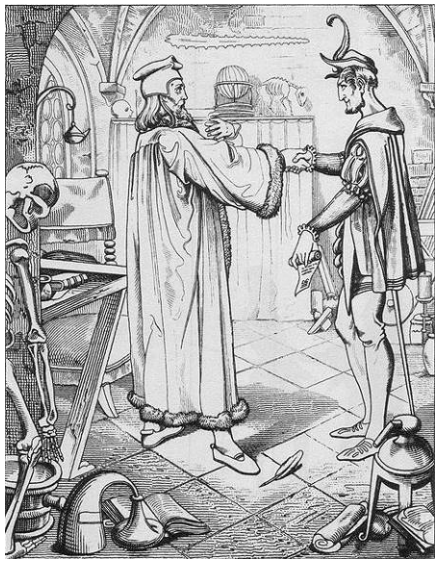


Figure 9. Sample 5. Faust's Pact with Mephisto by Julius Nisle.
Source: Retrieved Jan 29, 2019 from https://www.faust.com/legend/pact- with-the-devil/

Phase 2 – The Field Study in humanized devils

Pre-Survey

To avoid the effect from different beliefs, there are only nonbelievers who were invited to join the survey by using online survey; eventually, 20 non-religious people were tested, and the researcher reviewed the pre-testing survey findings and feedbacks from participants to revise some points and finished the final version of survey.

Subjects and Sampling

After the pre-survey, some points were revised. The first point was combining the multiple choices and filling in the blanks in order to reduce the confusion when people did the survey, in an attempt to make the result more systematic and convenient for further analysis. Since the open questions were about how people recognize the devils, the answers were mainly related the body languages, facial expression, interaction between characters, costume, objects and other subjects. The second point was to sort out the answers as a multiple choice based upon the above-mentioned classification which has been filled in the blanks. In this survey, 80 non-religious people were distributed by www.wjx.cn.

Phase 3 –Findings and contribution:

The first finding was the attitude of how people look at devils and the reasons as figure 10. 40% people held neutral position about devils. The people who mentioned devils were good and bad alike were both part of a whole, and they did not believe in its existence and were uncertain whether or not the images are beautiful or ugly. 32.5% people claimed that they like devils because devils are mysterious, attractive, powerful and competitive. Only 27.5% people dislike devils because they are horrible and terrible.

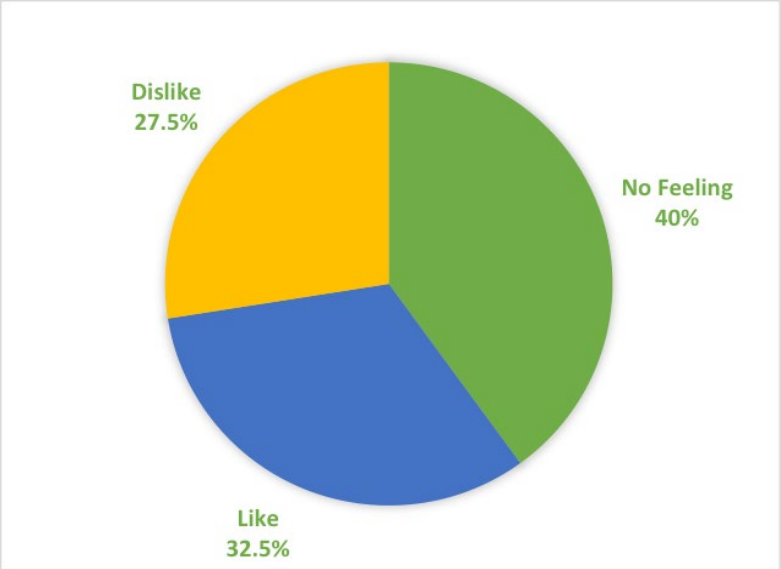


Figure 10. The attitudes of how people look at devils and the reasons.

However, there are 83.75% people using negative words such as evil, horrible, terrible, dark, mysterious, unpredictable and fascinating to describe devils. In other words, some people used negative words even they like devils or held neutral position about devils. For the study of the hit rate of the recognition for humanized devils in five sample pictures,60 % answers show that people recognize humanized devils correctly, which means that the humanized devils were recognizable in average.

As for the determining factors for recognizing humanized devils and the hit rate of specific category, as seen in table 2, 39 % answers show that people recognize devils based upon their facial expressions, 22% on body languages, 15% on costumes, 12% on the Interaction between characters, 9% on other subjects and 3% on objects. Yet the ranking of the percentage of determining factors was not the sole indicator for recognizing humanized devils, compared it with the hit rate of specified category as in table 3, the first finding was interaction between characters who held the highest hit rate of specified category at 83% while it held the third lowest percentage of determining factors at 12%. It means that

although there are only few people choosing Interaction between characters as the key factor of choosing, the hit rate reached the highest one among all. Hence, Interaction between characters is still worth more attentions.

Another finding needed to be highlighted is facial expression which got the lowest hit rate of specified category at 54% but got the highest percentage of determining factors for recognizing humanized devils at 39%. Though most people paid attention on facial expression, it also leads 46% people to misunderstand who was the devil, and it means the details of facial expressions which need more study about how to deliver more accurate messages to the audience. An interesting phenomenon is also presented in other subjects and object, which rank the second and third highest in the hit rate of specified category but rank second and lowest in the percentage of determining factors for recognizing humanized devils. In contrast, costumes and body languages ranked the second and third lowest in the hit rate of specified category, but got the second and third highest in the percentage of determining factors for recognizing humanized devils.

To sum up, the ranking of determining factors for recognizing humanized devils was an important reference for designers. However, the hit rate of specific category which shows different result is found in the hit rate of specific category. For example, facial expression held the opposite result in two rankings, but it does not mean that facial expression was not important. The reasons for the lowest hit rate of specific category might be because audiences have no basic knowledge about the story in each illustration, and so they might make decision only based on their personal experience and stereotypes as table 4.

Table 2. The percentage of determining factors for recognizing humanized devils

Ranking	Category	Percentage of total 400 answers	Number of total 400 answers
1	Facial Expression	39%	156
2	Body Languages	22%	88
3	Costumes	15%	60
4	Interaction between characters	12%	48
5	Other subjects	9%	36
6	Objects	3%	12

Table 3. The hit rate of specific category

Ranking	Category	The hit rate of specify category	Number of total 400 answers
1	Interaction between characters	83%	40
2	Other subjects	80%	29
3	Objects	75%	9
4	Body Languages	70%	62
5	Costumes	67%	40
6	Facial Expression	54%	84

In the study of the detailed studies of the determining factors for recognizing humanized devils as table 4, in terms of the facial expression, actual devil was described by the word of sharp eyes, laugh in one's sleeve, weird smile, threatening smile, false smile, pride and displeasure, gloomy face, cunning expression and confidence expression. Other wrong answers were sickly eyes, looking straight at beauty or people, draw the brow together, pale and stiffness, sensuality, sinister expression, fierce face, and poker face.

The actual devil in body language was about lure people with body, stretched out hand to seduce people, strong handshake, lower one's head to lure passers-by, lower one's head with no eye contact, giving horrible thing, tempted with beautiful body, sexy body movement. Other wrong answers were described as being attempted to escape, lower one's head and bow down, cheating, physical contact with others, and lean forward.

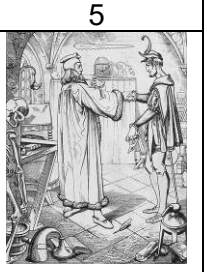
In the costume, people recognise actual devils as dress up as ghost, witch dress, funny wear, black dress, luxury dress, revealing dress, horn cap, dress differently from everyone else, and nude. Other wrong answers were like a mythical devil, sorcerer dress. In terms of the style of dressing like dressed in rags, armed with weapons, or hidden under her clothing.

The actual devil in Interaction between characters was concerned about being despised or feared by others, deceiving people by perfect appearance, active communication, instigating people, luring someone into the water, watching with vigilance, little monster lure people, make deal with people. Other wrong answers were not interacting with people, little boy bow down to her.

In terms of the objects, actual devil was depicted by the words of hidden sword, intend to dragging people down into the lake, concentration of energy. Other wrong answers were pen on the ground after signing, bone on the wall. In other subjects, people recognised actual devils as female, bony face, Faust, or cheater. Other wrong answers were bony face or black feet, which did not match the characters.

In short, the first finding in the detail of the determining points for recognizing humanized devils was about overactive and too passive behaviour, looking and dressing such as black dress. The second point was related to temptation such as luring people with body. The third and fourth points were stereotyped image of devils like witch dressing and being despised or being feared by others such as little boy bowing down to her. Other points were about gender and the figure of characters like bony face, the background of the pictures and objects related to death such as bones on the wall.

Table 4. The detail studies of the determining factors for recognizing humanized devils

No.	1	2	3	4	5
Pictures					
A. Body Languages	Stretched out hand, lure people with body, lower one's head, instigate people.	Stretched out hand to seduce people, lower one's head and bow down.	Sexy body movement, lower one's head to lure passersby.	Lower one's head with no eye contact, giving horrible thing, tempted with beautiful body, cheating.	Strong handshake, physical contact with others, lean forward, attempted to escape.

B. Facial Expressions	Weird smile, sickly eyes, sinister expression.	Pride and displeasure, poker face, pale and stiffness, sensuality.	Weird smile, look at the beauty, poker face.	Laugh in one's sleeve, gloomy face, fierce face, sharp eyes, looking straight at people, draw the brow together.	Threatening smile, sharp eyes, cunning expression, false smile, confidence expression.
C. Costumes	Dress differently from everyone else, armed with weapons, hidden under her cloth, dressed in rags.	Nude	Revealing dress, dress up as ghost, like a mythical devil.	Black dress, luxury dress, witch dress.	Funny wear, horn cap, sorcerer dress.
D. Interaction between	Active communication , watched with vigilance, lure someone into the water, not interacting with people,	Instigate people, little monster lure people, little boy bow down to her.	Deceives people by perfect appearance.	Despised or feared by others.	Making deal with people.
E. Objects	N/A	N/A	Intend to dragging people down into the lake.	Concentration of energy.	Hidden sword, bone on the wall, pen on the ground after signing.
F. Other subjects	Female, Black feet, bony face.	Female	Female, the character does not match the background	Female	Bony face, Faust, cheater.

Remarks: The underline represent the correct answers.

In the study of the description of the devils as table 5, the first finding was people were using the same or very similar adjectives frequently to describe the actual devils in different sample pictures, such as alluring has reached to 36, while beautiful only reached to 24, and evil barely reached to 11.The second finding was some descriptions which were found in both actual devils and normal characters like insidious could reach to 32, deceitful reached to 13, gloomy reached to 9 and weird reached to 7. The description from both actual devil and normal character which lead most people at 26 to misunderstand. In sum, all of these words were considered as relative important references in this study.

Table 5. Description of the devils

Sample	A.	B.	C.
1.	Alluring (5), beautiful (4)	Initiative (1)	Insidious (26), silence (5), weird (4)
2.	Gloomy (3), diseased (3)	Alluring (9), Sensuality (6), threatened (5)	/
3.	Disguised (2)	Alluring (22), beautiful (15)	/

4.	Gloomy (6), evil (5), beautiful (5), dark (4),	Indifferent (5), aggressive (3)	/
5.	Wise (3), deceitful (2)	Deceitful (11), Insidious (6), evil (6), weird (3)	/

Remarks: The underline represent the correct answers.

3 General discussion

In terms of studying determining factors and hit rate of specific category, the result in the percentage of determining factors for recognizing humanized devils as table 2 and the hit rate of specific category as table 3 showed that facial expression got the higher percentage in determining factors, but the lowest hit rate specific category. While other objects got the second highest hit rate but only few people chose it as a key feature to recognize devils. Thus, it can be seen if designers present the illustration independent from the text like this survey, designer should not only pay attention to determining factors, but also consider the impact of audience experiences and stereotypes which might affect the hit rate for recognizing humanized devils.

In the study in description, the positive description such as beautiful face, negative description such as afraid of looking at others and neutral one such as stretch out hand can be found in table 4, which means the image of devils in people eyes was diversified including both positive and negative. There are some similar or same descriptions in both actual devils and normal characters in table 5. In fact, the main idea, which designers need to be aware, was what elements made people think the specific one is devil.

Comparing to the study of the theories and analysis of body language and facial expression, the background of stories in sample pictures and determining factors for recognizing humanized devils as table 4, the illustrators or artist are using some body languages and facial expression in the pictures to tell their stories. Liu (2003) mentions some theories of body languages and facial expression were matched with what the samples pictures showed. For instance, in the picture of *the witch Maiden saw the young man under a tree by Henry Justice Ford* as figure 7, the witch Maiden used the body languages by the head tilt to show men her beauty, which signified the story about Maiden tempting the youth by her beauty and asked him to spend the night with her. The interesting point was also found that some audiences claimed that they think the witch lower her head to lure passers-by by her sexy body movements, and it was a good example for accurate visual messages delivery from illustrators to audiences. That is to say, designers are potential to apply the theories of body languages and facial expression to their works.

In term of the study of description of the devils, the description from two actual devils includes beautiful, evil, alluring, and the description from both actual devil and normal character includes deceitful, gloomy, weird, insidious, and all of these words were considered as relative important references in this study.

4 Conclusion

The research focuses on thoroughly humanized devils, the motivation is it relatively difficult to identify compare with theriomorphic (animal-form) devils and half human devils. This study starts with literature review to know how artists presented devils in the past and what is the potential development. In order to enhancing the communicate effectiveness by the

images between artists and audiences in the future, questionnaire survey is the appropriate method to understand about what messages were received by people.

From the survey, there are 27.5 % people claiming that they dislike devils, even 83.75% answers show that the descriptions are negative. It is the interesting point to start a systematic study into humanized devils especially how people can recognize humanized devils by questionnaire survey. Although the devils have the human faces in sample pictures, there are 60% answers showing that people recognize humanized devils correctly. Hence, it is a good point to discover what were their views about humanized devils in the sample pictures.

In term of the research contributions, the result from survey found that people recognize devils based upon the facial expressions, body languages, costumes, interactions between characters, objects and other subjects, which is to say that illustrators, designers and artists can use it as a guideline to create a design or artwork, further to enhance the communication effectiveness with audiences and avoid misunderstanding.

Figure 11. Sample picture

This research includes some samples about how the guideline can be applied to the illustrations or artworks. The body language and facial expression got the highest percentage of determining factors for recognizing humanized devils, which have an obvious impact on the communication between illustrators or artists and audiences. According to the body language and facial expression theories from the book of graphic body language password Liu (2013), the Idler by Albrecht Dürer as figure 11-A, artist used the hand posture of devil helped to speak out the emotions to express affections which matched both the story telling and some audiences' thinking.

The similar approach is also found in *how Morgan Le Fay gave a shield to Sir Tristram* by Aubrey Beardsley as figure 11-B, the analysis of body languages and facial expressions were about the witch Morgan who did not look at each other when talking to the other person. She was trying to cover up what she was trying to cover up. Sir Tristram, who was deeply frowning and worried, was trying to escape from the current situation, but for some reason this purpose cannot be completed, and there are many kinds of feelings of frowning, including doubts and fear. His lower lip goes up, indicating that the outside information he received was unbelievable and sceptical. Some audiences were successfully recognized the devil because of these body languages and facial expressions.

Faust's pact with Mephisto by Julius Nisle as figure 11-C, the analyses of body language and facial expression were about the devil looking someone straight. In that case, there must be something to be hidden, and he did not frown with a fearless facing to look into someone eyes, representing that he was invasive, and he picked on his edge of mouth, telling that he was smart, intelligent, extroverted, and smooth talker. This kind of method is consistent with character images, and the visual message delivery was relatively accurate.

In other words, the theories of body languages and facial expression is worth to study further in the future in order to enhance the efficiency of visual communication.

New knowledge from the research is also including the determining factors for recognizing humanized devils, the hit rate of specific category, the detail studies of the determining factors for recognizing humanized devils and description of the devils, all of the results were considered as relative important references and supports in future study for researchers, visual artists and designers .

In conclusion, this research contributes further support to a systematic guideline for visual presentation of humanized devils in Illustration design. In that case, illustrators and artists can create their own works based upon the research findings as a guideline to make their works stronger and deeper. Meanwhile, they can also deliver more accurate messages to audiences. For future study, this research is also a good starting point and structure for further study in related topic concerning the visual performance of humanized devils in illustration design.

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Authenticating Typography in Cultural Festival Brand Marks.

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Typography is a dominant feature which performs a central role in the branding and advertising of cultural festivals. This paper discusses how typography can be used to achieve authenticity in cultural festival brand marks culminating in strong, durable branding. With few controlled studies examining this nuanced area there is a scarcity of research addressing the role of typography within this phenomenon. The aim is to evaluate the way these properties contribute to either effective or ineffectual brand communication for a cultural festival. Regarded as destination attractions, cultural festivals commit significant capital to branding events in an effort to capture the tourist dollar. What follows draws on a 4-year study of cultural festival brand marks a decade and a half into the 21st century. Occurring between 2016 and 2018, 260 festival brandmarks were surveyed from a pool of 5408 from 18 English speaking countries. The methodological approach involves data collected in a case study method with a content analysis. We consider the significance of typography as it is positioned within communication design research reflecting on the current milieu of the discipline. The findings demonstrate that particular typefaces aimed to attract audiences and were seen as both unique in their application but also universally appealing; that Sans Serif trumps Serif typefaces and that typefaces signified differential conditioning underpinned by trade convergence. Finally we offer a discussion of these findings to qualify the potential pathway to either effective or ineffectual brand communication capitalizing on the persuasive arrangement of typeface elements to attract audiences.

Keywords: Typography, Cultural Festivals, Brand Marks, Tourism, Design Research

1 Introduction

Governments invest over 7.8 trillion (US) dollars per year into tourism-related industries and infrastructure; receiving revenues of an average 10% of the world GDP in return (Balakrishnan, Nekhili, & Lewis, 2011). The tourism industry globally supports one in every ten jobs. Tourism is an important economic activity in most countries with significant direct and indirect impacts (Manzo, 2019). Tourism is a competitive battle for prosperity, traffic and growth underlined by rapidly changing trends. As one of the fastest growth sectors in the world international tourist numbers reached 1.4 billion two years ahead of forecasts from the United Nations World Trade Organisation in 2018 (UNWTO, 2019). This is predicted to increase by 4% p.a by 2028 to over 2 billion tourist arrivals (Manzo, 2019). Considered destination brands cultural festivals are included in the economic matrix of tourism and draw

on and produce significant fiscal, social and cultural capital. Authenticity is the benchmark against which all brands are now judged (Grant, J., as cited in Beverland, 2009). Authenticity of typography's nuanced features in cultural festival brand marks can culminate in establishing strong, durable branding for cultural festivals. Our focus is on charting typography in the brand marks of cultural festivals across a range of international examples to discuss key qualities which accomplish effective or ineffectual brand communication. What follows typifies the salience of typography in brand marks seeking to exemplify typography's role in what is now a billion dollar festival ecology. All brands desire a strong and solid reputation (Aaker, 1997) and this paper offers a potential pathway to that station by capitalizing on the persuasive arrangement of typeface elements to attract audiences.

Typography is excluded from much academic literature examining the branding, tourism or place-making perspectives of the festival scape as such knowledge about the complex role it performs is limited (Amar, Droulers, & Legohérel, 2017). Contributing to the construction of knowledge in this area what follows establishes typography as an overlooked yet essential element of cultural festival brand marks. This is achieved by presenting a summary of the evolution of typography in this context with empirical examples from a controlled study of 260 festival brandmarks surveyed from a pool of over 5408 from 18 English speaking countries. The festivals occurred between 2016-2018 and the brand marks provide a portrait of design artefacts a decade into the 21st century. A case study method involving content analysis allows for a deep understanding of the phenomenon. The content analysis engages a contemporary typeface classification system to subdivide the typefaces used in the festival brand marks with findings from this technique informing a case study. The case study engaged cultural festival directors and designers of festival branding in semi structured interviews. The findings demonstrate that particular typefaces aimed to attract audiences and were seen as both unique in their application but also universally appealing; that Sans Serif trumps Serif typefaces and that typefaces signified differential conditioning underpinned by trade convergence. We discuss these findings to qualify the potential pathway to either effective or ineffectual brand communication capitalizing on the persuasive arrangement of typeface elements to attract audiences.

2 Background - Literature Review

2.1 Tourism & Place Branding

Tourism, defined as the activity of traveling to a place for pleasure emerged as an expression in 1811 (Webster, 2019). In recent times, consumers have become interested in the appearance and settings within which they live, work, and take vacations (Weaver, 2009). This interest feeds industry practices driving the competitive demands of place that have evolved into a complex sector. Far reaching, expensive and where branding is big business place branding is based on the conceptual domains of urban and city policy and of tourism. It is the application of branding principles to a place or destination, whose goal is to distinguish the destination from other locales. A city's brand is increasingly considered an important asset for urban development and an effective tool for cities to distinguish themselves and improve their positioning (Ashworth & Kavaratzis, 2007). People respond to places as they respond to brands, places can acquire and lose equity like brands and are accompanied by visual identities just as product brands have logos (Anholt, 2010). Scholars argue that a place's prosperity and progress can only be assured through creating and maintaining positive brand images (Govers & Go, 2009). Places need to operate like

businesses if they are to respond to increasing global competition and technological change (Kotler, Haider, & Rein, 1993). Places unwilling or unable to cultivate a competitive brand will find it increasingly difficult to win their share of the worlds – consumers, investment, talent, cultural exchange, respect and attention (Anholt, 2007).

2.2 Cultural Festivals

A key dimension of human society, cultural festivals occupy a significant place within our community, cultural and social ecology (Phipps & Slater, 2010). Defined as a one off, annual or bi-annual events festivals celebrate places, histories, cultures or events (Gibson, Waitt, Walmsley, & Connell, 2010). They have long contributed to the social fabric and cultural and economic development of towns and cities around the world (Taylor & Kneafsey, 2016). They are also a major source of income and tourism at local and national levels (Pessoa & Deloumeaux, 2015). Serving the discourses of place making and city making, festivals are often strategically conceived with the purpose of promoting a 'distinctive city' (Johansson & Kociatkiewicz, 2011). Possessing the hallmarks of destination branding or place brands cultural festivals share some of the attributes that influence visitors' decision to visit such destinations. (Blain, Levy, & Ritchie, 2005; Cooper, Fletcher, Fyall, Gilbert, & Wandhill, 2005; Esu & Arrey, 2009). As destination brands, festivals and other cultural events are seen as a means to contribute to a positive image of a place and to create employment opportunities to further economic growth (Herrero, Sanz, Devesa, Bedate, & Del Barrio, 2007). Strong brands drive demand and pricing power (Aaker, 1997; Badenhausen, 2018) in all economic sectors. The Edinburgh Fringe Festival illustrates the power of a cultural festival to successfully engage with the attributes of place branding. With a value of over £200 million, the festival is Scotland's most lucrative event well ahead of the St Andrews Golf Tournament and The Royal Military Tattoo (Ferguson, 2019). Similarly, the world's largest outdoor festival, Glastonbury, is estimated to be worth £82 million (Tremethick, 2016). If Glastonbury Festival was a country it would have a GDP of nearly £6 billion, ranking it 150th on the global league tables behind Guinea and above Somalia (2016).

2.3 Typography

The art of arranging letterforms, typography, in combination with colour and graphic features performs an essential role in cultural festival brand marks (Meyrick & Taffe, 2017). Typography is a highly visible brand element, which retains a lasting legacy in the digital age. The functions and limits of typographic meaning are much debated. Warde ascribed that typography is best when inconspicuous, like a fine crystal goblet – revealing, rather than hiding the beautiful contents therein (Warde, 1955). We argue however, that there is meaning beyond the linguistic carriage of letterforms. Here typography is not an end to a message, but the beginning to additional signs of meaning potential (Swann, 1991). Interpreted as a semiotic system (Brownie, 2009; Serafini & Clausen, 2012; Stöckl, 2005; Van Leeuwen, 2006), the visual rhetoric of typography can possess an augmented meaning that when contextually based reflects particular cultural values (Kostelnick, 1990, 2007; Welhausen, 2018). Over 70 years ago McLuhan denoted that the medium through which a message is communicated carries a message independent of the content it conveys (McLuhan, 1962). The evidence of the power of fonts with meaning potential, has been sufficient to establish legal argument with the European Court of Justice, which in 2003 granted brands the power to invoke 'unfair advantage' and 'detriment' against other brands using similar fonts and typefaces in similar categories (Thangaraj, 2004). Typography performs a particular role in a cultural festival brand mark, with precise communication of

brand values to recipients paramount for the success of a brand message (Kay, 2006; McCarthy & Mothersbaugh, 2002). Here, typography is relied on to establish the symbolic values and representations of the key features of cultural festivals - urban freedoms; rich histories, cultured places, playfulness and stimulation that seek to subvert our daily existence while performing the task of engaging local, national, and international visitors and participants (Gibson & Stewart, 2009).

3 The Purpose

The purpose of this paper is to provide a key introduction to the fundamental role of typography in cultural festival brand marks establishing how authenticity can be achieved through the nuanced treatment of type in particular contexts. This paper offers a potential pathway to that station by capitalizing on the persuasive arrangement of typeface elements to attract audiences. Considered destination brands or place brands we position cultural festivals against the backdrop of global tourism situating the history and importance of cultural festivals in society. This is achieved to ascertain a hallmark of usage not currently documented in academic scholarship subsequently forming a baseline to further investigate the power of typography within this phenomenon. We consider the impetuses behind the ways typography materializes across a large corpus of evidence. Allowing for a discussion of the social and cultural associations and implications of typeface usage. Providing connections between the current milieu of contemporary typography research the findings demonstrate that particular typefaces aimed to attract audiences and were seen as both unique in their application but also universally appealing. That Sans Serif trumps Serif typefaces and that typefaces signified differential conditioning underpinned by trade convergence. We offer a discussion of these findings to qualify the potential pathway to either effective or ineffectual brand communication capitalizing on the persuasive arrangement of typeface elements to attract audiences.

4 Method

The study from which this paper is drawn, samples cultural festival brand marks a decade and a half into the 21st century. Our unit of analysis emerged from a 4-year study of 18 English speaking countries and occurred in the time period of January 2016 to December 2018. 260 festival brandmarks were surveyed from a pool of 5408. The methodological approach taken involves data collected in a case study method with a content analysis. The criteria for selecting the range of countries encapsulates; alignment with the language competences of the researchers; enables a broad casting to include countries whose native tongue corresponded to the researchers; the authors considered it disingenuous to include cultural festival brand marks from countries where languages other than English was used, as this misaligned to our knowledge and scholarship in this area. The brand marks were sourced via a scoping of 18 country websites where government, local council, tourism boards and organisation listings were trawled to create a master catalogue of 5408 cultural festivals. Using the website www.randomizer.org we random sampled this master catalogue to generated a final subject group of 260 cultural festival brand marks. We anticipate that this final subject group represents the whole and is indicative of the large sample group.

Typography as it appears in the brand marks of cultural festivals are our phenomenological subject matter. We adopted a direct approach to examining the form and the configuration of artefacts (Cross, 1999), that result in a conscious investigation of the products of design.

Research for any subject requires consideration of the extant theory within its field and the contrasting perspectives upon the phenomena of interest (Cash & Snider, 2014). In light of conjecture concerning preferred research methods in design research, (Cross, 1993, 2006a, 2006b), we support Archer's exposition that design research is systematic inquiry whose goal is knowledge of, or in, the embodiment of configuration, composition, structure, purpose, value, and meaning in man-made things and systems (Archer, 1981). We frame this by engaging a case study method with content analysis, this approach allows for the emergence of a multifarious and propitious understanding of the phenomena of interest. We argue this tactic ensures a greater consideration of not only the form of typography but also a framing of its context, which is often overlooked in academic research (King, 1999; Rose, 2001; Thangaraj, 2004). Firstly content analysis, is used to evidence the form of typography across a large corpus of material gaining a 'point of view' of the brand marks under investigation. Secondly a case study method steps into the brand marks, allowing for deeper analysis of the materials. Here, we interviewed festival directors and designers of cultural festival brand marks and probe specific queries about typography.

Defined as the study of recorded human communication (Babbie, 2001) content analysis, is a research technique for making replicable and valid inferences from data to their context (Krippendorf, 2013). Using a content analysis method we applied Krippendorf's five procedural processes – Unitising, Sampling, Reducing, Inferring and Narrating (Krippendorf, 2013).

Table 1. Krippendorf's Content Analysis Method (2013) and how this is used in this study.

#	**Krippendorf (2013) Technique**	**This study's translation of technique**
1	Unitising: Identifying the units of analyses.	Cultural Festivals in 18 English speaking countries between January 2016 - December 2019.
2	Sampling: Selecting from a study - those units.	Generate the master catalogue of cultural festival lists 5408. Use randomizer.org to secure a final subject group to 260 brandmarks, this is based on populations segments to allow for fluency and validity of sample size to populations size.
3	Reducing: The content of non-numerical data is reduced to its "essentials" by coding and statistical analysis.	We used Bevington and Chong's (2013) typeface classification system to classify all festival brand marks.
4	Inferring: The frequency counts of the coded material and other statistical information about the phenomena under investigation are linked to the research question and the context, within which the material is located.	Engaged NVivo software to assist in the count frequency of the coded material. Our results inform our Case Study Method
5	Narrating: The results of the study are communicated narratively in reports, journals, and other outlets.	Our results are shared.

Source: Krippendorf's Content Analysis Method (2013) and this study's content.

From our final subject group we characterized and sorted frequently appearing attributes of typography evident in cultural festival brand marks. Bevington and Chong's Typeface classification system divides typefaces along contemporary divisions, aptly representing the past 500 years of advances in typography (T. Childers, Griscti, & Leben, 2013). Although no typeface classification system is fool proof, the use of this particular system guideposts or frames our approach to developing a taxonomic system of typography in the brand marks. The features of the typefaces generally fit into what is known as Serif, Sans Serif, Slab Serif or Topical, Freehand or Black Letter categories. The process of sign posting eliminates what may have been the influence of the researcher, ensuring interpretation is limited (Krippendorf, 2013).

5 Findings

The findings of the content analysis demonstrate what the form of typography looks like in the brand marks of cultural festivals across a large corpus of design materials. The content analysis uncovered that Bevington and Chongs' (2013) Text category incorporating Serif, Sans Serif and Slab Serif was used in 64.6% of the brand marks surveyed. Display typefaces, including Freehand, Topical and Black Letter were used 35.3% of the time. 63% of the typography was set in all Uppercase. 76% used a variety of additional graphic features in their brandmarks such a geometric shapes or elements including moustaches, wine glasses, film strips or shrimp. Arts festivals were the most frequent festival category in the randomized subject group. Findings revealed the most recurrent use of typography at 67.1% was Contemporary, Sans Serif Text typefaces, predominately set in Uppercase with additional use of graphic features.

Ask Siri how many fonts there are in the world, and her answer is, 'perhaps 300,000'. We were curious, if there are so many different typefaces, why do almost 65% of cultural festival brand marks use typefaces that are so similar? Of those 67% belong to the contemporary Sans Serif category. We sought explanations to our findings and approached festival directors and designers, to contribute in a series of interviews which we framed in a case study. We interviewed festivals directors and communication designers in Australia, England and America, all who designed brand marks for cultural festivals, or made key decisions about the typography in the festival branding. The set of questions specifically sought to determine how - *the typeface they used in their brand marks attracted the intended audience*? We enquired - *how the festivals specific use of typography was unique in the brand marks? How the typography in the brand mark was different from their competitors? And what their point of difference was in their specific typography usage in this context*? Responses were varied.

5.1 Typeface aims to attract audiences.

Regardless of the kind of festival they designed for, such as arts, music, tech or performance all participants, stated that their use of the typeface attracted the right audience. Of these response, all participants noted that the success of their brand mark was indicative of 3 components; the typeface, the colours and the graphic features used. P.M. (2019, February 25). Personal Interview, stated that typography plays a key role in developing the right branding that will move tickets. D.J. (2019, January 21). Personal Interview, stated the aim was to reflect the avant-garde programming of the festival. Additionally, to push the language of typography imbued with a sense of visual warmth that elevated the small town festival he was designing for to big city status through branding, thus ensuring the branding

worked hard for the festivals' position. F.A. (2019, February 11). Personal Interview, stated that, the Sans Serif Modernist typeface attracts both a new audience through the familiarity of the style of typeface prevalent in contemporary design and also retained the older audiences via recognizable features similar to that in early Jazz record albums from Blue Note and ECM recordings that the audience would be familiar with.

5.2 Typefaces as Unique

100% of participants stated that their specific use of typography in their brand marks was unique. This is contrary to our findings where 65% of typography used in the festival brand marks are similar and reside in one category. Qualifying a response, in designing for an Jazz Festival, F.A. (2019, February 11). Personal Interview*,* stated he had looked to other type styles, including Serifs to be used in the branding yet the Sans Serif Modernist face 'spoke to everybody'. In his experience the face is a 'neutral platform, it's universal and classic'. Similarly, H.G. (2019, January 22). Personal Interview*,* stated his team attempted to change the typeface every year but essentially now try to use a font that is universal whereas in the past we have had more funky fonts that reflect the techy nature of their festival. He stated the current typeface is a modular font that is presented on an oblique, skewed right. D.J. (2019, January 21). Personal Interview, offered that, he used a dynamic contemporary typeface that could be modular in its application to a variety of media and channels. P.M. (2019, February 25). Personal Interview maintained that both her and the Creative Director of the festival are aesthetically aligned to the Swiss Style and find themselves gravitating to it.

5.3 Sans Serif Trumps Serif Typefaces

In all the interview responses, Sans Serif typefaces trumped the use of Serif typefaces. F.A. (2019, February 11). Personal Interview, maintained he had looked to other type styles, including serifs to be used in the branding yet maintained the Sans Serif Modernist face 'spoke to everybody'. D.J. (2019, January 21). Personal Interview, brought a flexible approach to resolving a new festival logo ensuring a dynamic contemporary form that could be modular in its application to a variety of media and channels. DJ was very clear that this wasn't going to mean going to a Script or a Serif font, rather this enabled the Sans Serif typeface to visually appear in a variety of different weights. Considering all of this, DJ had the freedom to choose his stylistic direction in the branding of the festival. Although not specified in the client brief, DJ manipulated letter characteristics of a Sans Serif face pushing them as far as they would legibly go to develop a new typeface that could be dynamic and event specific. His aim was to reflect the avant-garde programming of the festival.

5.4 Typefaces Signify Competitor Difference

All respondents sought branding that was different, this was obtained via three components of branding elements – the typeface, the colours and the graphics. F.A. (2019, February 11). Personal Interview, stated that their team had moved to use a specific colour (yellow) and as it hadn't been seen in metropolitan Jazz festival branding before. F.A. stated the position of the typeface as it appears alongside other graphic and colour elements made the difference, 'you don't need to have the type in an *italic*, **bold** and a different colour for it to work.' DJ and his team used a typeface which resided in the international swiss style of typography as it functioned well for the festival brand. The point of difference in the Festival branding was achieved via the use of large format type in the Modernist contemporary style. P.M. (2019, February 25). Personal Interview maintained, their approach to competitor difference was organic with the requisite that the on ground experiences relates to the aesthetics of the

overall brand, this emerges from a deep understanding of their annual theme working to create a unified whole.

6 Discussions

The identification, description and creation of value is the most important function of a brand mark (Mollerup, 2013). Organisations use their design programs to position themselves in a conceptual relationship with competitors thus an organisations identity is implicitly defined by the visual identity of other companies - it is differentially conditioned via trade convergence (Mollerup, 2013). Differentially conditioned brand marks are evident in the use of specific industry's with particular motifs. For example snakes have been used for centuries as symbols of worship, love, health and medicine and the repetitive use of this symbol enables the association of the symbol with medicine and pharmacy. Through this familiarity, when we see such symbols we associate them with particular industries. This is differential conditioning and it is now manifest in cultural festival branding through typography usage of Sans Serif typefaces. The use of a Contemporary Sans Serif is universal, it's modular and accessible and festival designers seeks this universality in their brand marks so use particular typefaces. The convergence of trade to reside near or next too competitors guarantees the attributes of these typefaces is relative to other festivals use of such typefaces and the attributes flow over to the similar brand marks.

Based on findings from this study, to achieve authenticity in festival brand marks, perhaps festivals need to occupy a space not too distant from competitors. L. Childers and Jass (2002) found that the effects on consumers perceptions of typefaces are influenced via 1) the consistent use of a typeface in a particular situation; 2) direct relations with the perceptual qualities of the type; and 3) abstract connotations. The results from the content analysis establish support of Childers and Jass' findings with 65% of festival brand marks residing in one category. Thus consumer perceptions are met with the direct expectations of the consistent use of a typeface in a particular situation. The universal and modular features of the typefaces that festival designers sought to capitalize on ensures that the relationship with the perceptual qualities of the type are familiar to all. Due to this the consumers experiences with the perceptual qualities of type are generally positive and this assurance suggests favourable grounding of the typefaces qualities in consumers' minds. The abstract connotations of consumers perceptions may be cited to reflect any number of previous semantic assumptions. Here, the use of modular and universal traits capitalized on the use of Sans Serif typefaces and are presented as a tactic to encourage favourable meaning potential. Thus authentic typography is constructed with consonance apt of the social and cultural implications of typeface usage in particular contexts.

7 Conclusion

This paper provided a key introduction to the fundamental role of typography in cultural festival brand marks establishing how authenticity can be achieved through the nuanced treatment of type in particular contexts. We considered destination brands or place brands and positioned cultural festivals against the backdrop of global tourism situating the history and importance of cultural festivals in society. This was achieved to ascertain a hallmark of usage not currently documented in academic scholarship, subsequently forming a baseline to further investigate the power of typography within this phenomenon. We considered the impetuses behind the ways typography materializes across a large corpus of evidence. In

this paper the findings confirmed L. Childers and Jass (2002) argument that there are three ways that typography may influence consumer perceptions. Achieved via 1) the consistent use of a typeface in a particular situation; 2) direct relations with the perceptual qualities of the type and; 3) abstract connotations. Providing connections between the current milieu of contemporary typography research the findings demonstrate that particular typefaces aimed to attract audiences and were seen as both unique in their application but also universally appealing. That Sans Serif trumps Serif typefaces and that typefaces signified differential conditioning underpinned by trade convergence. We offer that the culmination of these factors qualify the potential pathway to either effective or ineffectual brand communication capitalizing on the persuasive arrangement of typeface elements to achieve authenticity in attracting audiences.

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Design challenges towards materials: criticizing directions, stimulating debate, generating interdisciplinary circumstances.

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This research explores the emerging role of Design in stimulating people's commitment to materials, in inspiring their critical choices and expectations, in leading Science closer to society and aware of possible directions for the future of materials. It is claimed the urgency of defining opportunities for multidisciplinary discussions and interdisciplinary practices.
This can be achieved by establishing a specific approach of Design, based on the understanding of society in its complexity and its ability to create synergies and needs, to fuel scientific research and trigger innovation of materials on human factors.
This paper, from an overview of the current mainstream directions of Material Science and Technology, poses some questions to encourage an "out-of-the-box thinking", challenges conventions and underlines the need to engage with other disciplines and to create new interdisciplinary and multidisciplinary circumstances. A practice-based activity is described based on experiments with polymers, conducted through a hybrid methodology that combines chemical protocols and design methods, such as critical and speculative design, material speculation and RtD. A personal interdisciplinary approach developed in chemical laboratories is presented, discussing the results achieved and those expected in terms of contribution to the field of Material Design and Culture.

Keywords: Materials, Critical Design, Public Engagement, Interdisciplinarity, Chemical Laboratory, Experiments.

1 Introduction

Design's main objective is no longer to provide products, services, systems, but rather ways of thinking and facing this challenge, critically questioning and developing solutions or opportunities for complex social, environmental, economic and even political issues.

"Before being a technique, Design is a form of critical analysis and reflection that allows design experts to produce knowledge, visions and quality criteria that can be translated into feasible proposals." (MANZINI, 2016, P.54).

Ongoing transformations within the discipline are born in response to the emerging need for new ways of observing, learning and understanding the complexity of modern times, requiring a renewed knowledge of the dynamics rather than of individual point issues.

This is primarily due to the achievements of Technology and Science, which are drastically changing human life, facing and resolving people's very practical struggles. At the same time, inventions and discoveries of great technical and scientific impact are leading to yet incomprehensible and uncontrollable effects from a cultural and social point of view.

By operating on the boundaries between technology, science and society and through a cultural, economic and social lens, design plays an active role in this scenario and is called upon to contribute to its understanding and evolution, investigating the present and predicting possible futures.

In response to this task, Design has in recent decades developed consolidated approaches, such as speculative (DUNNE & RABY 2001, 2013) and critical (RATTO 2011) design, and has extensively incorporated practices of fiction design (STERLING 2005; RETZINGER 2008; BLEEKER 2009), aimed at exploring and questioning emerging issues in order to imagine and discuss prospective and most suitable futures (GAVER AND MARTIN 2000).

This article, based on a speculative and critical design born and used mainly in HCI research (STOLTERMAN & WIBERG, 2010), discusses the application of an investigatory and human-centered approach to material research and innovation, based on new ways of exploiting interdisciplinary practices that combine material science, product design and new craft approaches. Recently, Wakkary et al. (2015, P.97) introduced the concept of *material speculation*, which complements design fiction, and stated that *"This concept is based on the literary theory of possible worlds. Material speculation emphasizes the material or mediating experience of specially designed artifacts in our everyday world, creating or reading what we call counterfactual artifacts. Material speculation uses physical design artifacts to generate possibilities for reasoning. We offer material speculation as an approach to critical demands in design research."*

By borrowing and adapting the concept of material speculation, this research aims to use design products, artefacts and experiments on materials to stimulate people's awareness and commitment to materials. The goal is to define their critical choices and expectations and to lead science closer to society and more aware of the directions determining the future of materials, in an effort to create multidisciplinary discussions and interdisciplinary practices.

That means using a design approach, based on the understanding of society in its complexity and on the ability to generate interest and needs, to fuel scientific research and material innovation on human factors. This essay, from an overview of the existing main directions of Material Science and Technology, proposes some questions to encourage out-of-the-box thinking, to challenge conventions and underlines the need to engage with other disciplines to create new interdisciplinary and multi-disciplinary contexts. It is proposed an experimental research based on the practice of materials innovation that presents a personal interdisciplinary approach developed in chemical laboratories, and discusses the results achieved and expected in terms of contribution to the field of Material Design and Culture.

2 Background

This section offers an overview of this research context, looking at 1) the current dynamics related to the meaning of materials and innovation, the new challenges for Design and the resulting practices, approaches and methods; 2) the motivations and objectives for a real interdisciplinary commitment.

2.1 Emerging materials scenarios and new Design challenges

The importance and leading role of materials in the evolution of society is clear, as Miodownik writes, when we think of how all the key phases of civilization are named after a discovery or progress in the use or technological implementation of a specific material: Stone Age, Bronze Age, Iron Age, with the 21st century defined as the Silicon Age (MIODOWNIK, 2014).

Immateriality is one of the distinctive aspects of the current social, cultural and economic landscape: knowledge, collaboration, experience and interaction, once considered values "to fill things up", have now become themselves "objects" of purchase and consumption.

Even the enormous burden that materials have become over decades of industrial overproduction (pollution, waste, obsolescence) has contributed to the definition of a new, urgent and purifying need for immateriality. In this scenario, it is necessary to understand and redefine, the material apparatus, the relationship between the user and the physical nature of the products, in line with a new paradigm of a more conscious, ethical and demanding consumerism, by also enhancing new tools and forms of immateriality.

The physicality experience of things is both disorienting and exciting. It shifts due to the lack of connections between the material and its origin, its fruition and processing places, its place in our individual and collective memory. The latter is based on associations of aesthetic-functional characteristics and resources, geographies, landscapes, traditions, skills, tools and processes. New and more intangible and sophisticated technologies break the linear connections on the one hand, and on the other generate new dynamic and widespread bonds, where material and virtual intertwine and coexist (MALDONADO 2007) in the product with reversed roles, changing from a user interface to a tool of realization, as needed.

Today more than ever, Design has a major responsibility in redefining the product's material context: not only does it influence the choice of materials and production processes, but it also determines the methods of consumption and use, as well as the environmental and social impacts of the entire product life cycle.

Faced with problems of different nature that transcend disciplinary boundaries and require a hybrid approach between technologies and natural and human sciences, the designer must rethink his attitudes and skills, and take on a new guise, that Verganti (2013) calls "*radical researcher"*. Verganti describes a designer who, commissioned by a company to design new products, proves to be an expert in his ability to imagine and investigate new meanings across social, cultural and technological evolutions.The designer then becomes a researcher, instead of being a mere creator. Verganti defines creativity as culturally neutral, a useful and resolving tool, while research challenges an existing paradigm with a specific vision on which to converge. In the specific case of this research, the designer not only works as a contractor, but also produces new knowledge about the material apparatus of our society and its processes of innovation, production, processing and selection. The paradigm is still the same. Designers interpret connections and map meaning and relationships, building networks of knowledge.

Carla Langella (2018) investigated the contemporary design scenario and suggested new ways of processing materials and artefacts, paving the way for a new innovating process through the project itself. She identified the changes needed in all design aspects and

procedures in order to pursue "*deep innovation"* in this new view. She argues that the designer must be able to manage the extent of his scope of intervention with technical competence, experimental mindset and foreshadowing skills, while schools and universities must also adapt. This means training new professionals with tools and technical skills related to materials and technologies, promoting their ability to translate ideas and visions into concrete experiments. Ideally, hybrid structures should be created for simultaneously training and experimentation, including the academic, research and production fields, with the goal of fostering advanced professional talents.

Manuel Kretzer, architect, designer and research assistant at the Chair for Computer Aided Architectural Design (CAAD), Department of Architecture, ETH Zurich, is an example of a contemporary design approach to material innovation. He considers himself an explorer of potential new materials and his approach has a significant educational value. He attempts to understand some smart materials, having no clue how they could be used. That way, he looks at unusual potentials or, often unknowingly, reaches the performance limits of a particular material and learns how it works. He proves that by rebuilding the material with our own hands, we can manipulate and adjust certain properties and discover their potential value in connection with specific design needs. However, the goal is not to improve the performance or efficiency, but rather to demystify the idea of technological progress as something inaccessible and try to create a more accessible basic knowledge. Kretzer's work aims to reveal, inform and inspire. The *materiability* research network he founded in 2012 is a community platform, educational network and open database of materials that allows in-depth access to developments of emerging materials, specifically for architects and designers. Indeed, a major problem in dealing with these technologies is that they are often either scientifically falsified or only available as hyper-oriented products with limited and very specific characteristics. The site provides an ever-growing database of a wide range of materials, lectures and tutorials on self-production of these materials and promotes their assembly in speculative experimental projects.

This combination of information, education and inspiration should help to develop a common language for interdisciplinary communication and bridge the gap between research, education and practice. A Design approach that combines practical and implementation activities with a speculative and theoretical approach is RtD, Research through Design. As Durrant (2017, P.3) states: *"Research through design has been used for over 20 years within the design community as a distinct term to describe a practice-based investigation that generates transferable knowledge. Probably, research through design is not a formal methodological approach with a particular epistemological basis. It is instead a fundamental concept to approach the investigation through the practice of design [.....]."*

2.2 The role, approaches and interdisciplinary engagement of Design towards Materials Research and Innovation

Our age appears as a *"[…] transition phase present[ing] itself as a mesh of long and lasting crises and, at the same time, as a broad, complex social learning process"* (MANZINI, 2016), which resembles an Age of Entanglement (HILLIS, 2010), characterized by a high level of complexity due to the uncontrollable tangle of connections and interactions between human and non-human that occur daily on a global scale. In order to understand and manage this complexity made of infinite connections today we are exploring approaches other than disciplinary, because, as Neri Oxman says (2016), *"knowledge can no longer be ascribed to, or produced within, disciplinary boundaries, but is entirely entangled. The goal is to establish*

a tentative, yet holistic, cartography of the interrelation between these domains, where one realm can incite (r)evolution inside another; and where a single individual or project can reside in multiple dominions."

In order to successfully manage emerging issues, both researchers and professionals from different disciplines must engage in their shared activities. This research aims to promote a shared workplace, even though not necessarily a shared project, so that researchers and designer can become mutual supervisors. *"Every expert knows a piece of the puzzle, but the overall picture is too big to be understood."* (HILLIS, 2010).

This research also explores the role of design in the field of Materials Innovation and Evolution.

Contemporary techno-scientific directions, without a public debate based on a careful consideration of human factors, such as time (memories), places (territories) and knowledge awareness), could result in new dogmas. We know that the selection and innovation of current materials is driven mainly by criteria such as environmental sustainability, but we still lack effort to prevent it from becoming yet another trend that could result in another monopolizing market. We need the public's involvement in materials research. We should use the design approach to fuel scientific research and material innovation based on human factors. Science and technology are significantly progressing towards solving practical problems, but since this is not essential to their discipline, they are not concerned about possible side effects. Scientists, as stated by the physicist Feynman ([1998];1999), are concerned with examining, understanding, discovering and producing new knowledge, with little or no regards to the ethical aspects of their own activity. Even when motivated by social or economic objectives, their activity does not involve decisions or assessments of the ethical or applicative value of their discovery. The same Feynman, in 1955 essay, argues that science is not concerned with identifying and proposing the most appropriate way to apply and use its discoveries because social problems are so complex, uncontrollable and subjective that their solution would require a magic wand, which is clearly not a scientific tool.

Science and technology pervade our daily lives and therefore require a "translator/interpreter/connector" to communicate their progress and results to society, made of "people-users" with a cultural background and daily needs.

As Karana et al. (2015, P.35) stated: *"Functional aptness is taken for granted at the first commercial launch of a new material—meaning that the 'material' should make sense from the perspective of a performance or utilitarian advantage. Nonetheless, this alone may not be enough for its commercial success and widespread use".* As Manzini (1986) says, a material should also be socially and culturally accepted - or acceptable; thus, the material should also make sense.

3 Experimental Research

This section discusses the ongoing research activity starting from 1) questions to probe the mainstream directions, investments and believes about materials, which lead 2) to the choice of the laboratory as space for producing new knowledge through debate and 3) describes the objectives, approach and methodology.

3.1 Probing Mainstream Materials directions

Could we think of the magic wand as a metaphor for the ability of digital and post-humanism to complicate operations through a simple hand gesture? Aren' t complicated processes and actions becoming invisible to the point that this superpower is getting us used to the idea that what we don't see is magically sustainable, reducing our capacity for criticism, care and interest in bulky, visible and tangible matter?

One of the most heavily funded fields of research in materials science is that of nanomaterials and nanoparticles. The fact that we can observe and work at the nanoscale has opened up a wide range of new and surprising possibilities for human progress, but does the fact that they are invisible mean that they are sustainable and harmless to health? Or should we be more concerned with understanding and imagining the consequences of their invisibility in our daily lives and on a global scale?

Another questionable aspect of the mainstream of material innovation is the considerable commitment and expectations we are investing in replacing synthetic polymers with biomaterials. As Nobel Prize winner Randy Schekman (2019) said, biology is one of the most complex sciences because of the huge number of variables involved in the balance of very intricate systems.

We are aware of the lengthy efforts that are still needed to transition to a man-made "biological" world. But, while we work hard to make it happen, are we concerned about the present?

Materials such as synthetic polymers, for instance, which we have grown accustomed to as they easily meet our daily needs, and which have represented last century's magic wand, have been criticized in a way that on the one hand raises the issue of environmental concerns, and on the other hand produces a new psycho-social phenomenon: a sense of guilt, frustration and impotence. This condition is exacerbated by apocalyptic scenarios exploited as a means of criticizing human behavior and choices in a brutal and destructive way through. Sensationalist and dehumanized aesthetics charged with anxiety and tension tend to be, thanks to their technological potential, extremely falsified and often deprived of any form of balance, desire and care towards present hopes and past experiences and eternal human fears. In this scenario, Design can make a difference.

First and foremost, it can contribute in the balance of variables, be they technical, semantic, anthropological or emotional. Design works on imagination and prediction, but it cannot escape modern limitations and opportunities, because it takes care of people's hidden needs, of materials and their transformation, it understands and controls the power of beauty, as a tool to trigger desire and care itself.

New materials and products can increase the visibility and tangibility of the complex dynamics that govern our behaviors, needs and expectations (KRIPPENDORFF & BUTTER, 2008). The material experience evokes ancestral deeply-rooted feelings and impulses, generating immediate and multisensory narrative patterns (HEKKERT & KARANA, 2014).

For these reasons, with its historical function of giving form, function and attractiveness to matter, Design is called upon to renegotiate them in relation to current production, cultural, social and environmental dynamics and through a critical and interrogatory approach. We need the public's dedication to materials research.

3.2 The lab as site of knowledge

Koskinen et al. (2011) define the lab as "a site of knowledge". They explain how many disciplines carry out part of their activities in the lab, a place where new knowledge is generated. Almost all phenomena can be extracted from their normal context and reproduced in the lab. This is useful because the external environment, the context, has too many simultaneous variables that interfere with a given factor or behavior, and it often becomes impossible for a researcher to determine a specific factor and its degree of influence

Therefore, the reproduction of a given phenomenon in the laboratory offers the possibility to focus on one thing at a time, which helps the researcher to seek alternatives and develop hypotheses. Moreover, the lab is equipped with a number of ready-to-use instruments that allow quick modifications, analyses, observations and measurements. Furthermore, everything that is observed in a lab is extensively documented, so that it can be reproduced in other labs and errors resulting from the research environment or culture can be ruled out.

For instance, a designer is able to build a prototype that actually translates the theoretical work into a hypothesis to be tested in the laboratory.

Stappers (2007) states that *"Prototypes and other types of expressions such as sketches, diagrams and scenarios are the main tool for a designer to build the connection between fields of knowledge and progress towards a product. Prototypes serve to establish hypotheses from contributing disciplines and to communicate principles, facts and considerations. They speak the language of experience, which unites us in the world. The design act of creating prototypes is in itself a potential generator of knowledge (if only his intuitions do not disappear in the prototype but are traced back to the disciplinary and interdisciplinary platforms that can include these insights in the growth of theory)."*

For the designer, creating a hypothesis to be tested means, for example, building a prototype, which, in fact, crystallizes the theoretical work and becomes a hypothesis to be tested in the laboratory. Prototypes can be used to test a theory, becoming materializations of theories or "physical hypotheses". Furthermore, they allow researchers to face those complex challenges that designers are presented with in the course of their work, thus stimulating them to concretely address their own theories. Similarly, through the proposal of prototypes, researches can confront each other with the outside world and with different opinions.

In this research, the designer uses the chemical lab to create prototypes, artifacts and new samples of materials (examples in **figures 1 and 2**) to promote debates with material scientists on contemporary issues and interdisciplinary interaction.

Figure 1. Samples of different Polyurethane foams obtained.

Figure 2. Prototype of material's manufacturing and expected expressions.

The project makes its activity visible, comprehensible and available to scientists by producing material results that are different from those typically obtained. The new results are not intended to be used by industries or economic systems, but to reach people's attention and curiosity.

This personal approach, which is currently part of a widespread view on contemporary design (LANGELLA, 2018; KARANA 2015), focuses on creating a shared workspace and tools with other disciplines. A setting similar to what Schön (2017) would call reflection-in-action, aimed at stimulating generative reflections in the practical activity unfolding in a situation of uncertainty, uniqueness and conflict (SCHÖN, 1971).

The approach is here intended as a training opportunity for researchers to become more effective through reciprocity. In fact, *"Effective professionals tend to think similarly in all professions. Surgeons, architects and attorneys may use different methods to achieve*

results but, in all fields, truly effective professionals think of problems in very similar ways. Professions can thus learn from each other." (NEUMANN, 1999, P. 404).

An experimental work on polyurethane foams treated as pretextual materials is described to discuss the possibilities and still unexplored advantages of "plastics"[1], that were behind the greatly productive, socio-economic revolution of the past century. The work focused on giving a new expressiveness and narrative force to an economic and commercial material, specifically one of those publicly demonized polymers, to exploit it as a counterfactual object and to promote criticism and consideration.

3.3 Blending Chemistry and Design: objectives, approach and methodology

The practice-based activity of this research is conducted at the laboratories of IPCB, Institute of Polymers, Composites and Biomaterials of the National Research Council of Naples, Italy, seen in **figure 3**.

Figure 3. Laboratories of IPCB, Institute of Polymers, Composites and Biomaterials of the National Research Council of Naples, Italy, where the experimental activity was conducted.

A cross-disciplinary interaction and debate involved a designer and a chemist working in the same space on the same type of materials (i.e. foam), but with different ingredients used to achieve different research goals. **Figure 4** shows the designer explaining her process.

[1] plastics is a very generic name for identifying synthetic polymers. In this case it is used to recall the negative connotation that is attributed today to a wide family of materials without a deserved and specific distinction of uses, properties and processes.

Figure 4. Designer working in chemical lab and discussing her activity.

The two activities explored one of the main areas of modern research: the replacement of polymers for biopolymers.

The chemist was working on the formulation of the bio-substitute of expanded polyurethane using cellulose and natural additives to obtain a more performing biopolymer. Biopolymer research is one of the top funded fields of material innovation, so the designer decided to carry out a parallel study in a critical and interrogatory light.

The intention was to undermine the mainstream paradigms, but not the validity and accuracy of the study, nor the suitability of the material itself.

To do so, it was decided to work on the original synthetic polymer in order to draw attention to it. The designer, at the nearby workstation, began to develop new expressions for the common polyurethane foam to give it a more appealing and desirable appearance. She then proceeded to create some artefacts, specifically some containers, and testing handcrafted processes to be applied to an industrial material as it were a raw natural one, like wood or stone. She began by following a scientific protocol for the formulation of flexible, rigid, open-cell and closed-cell PU foams to achieve the desired result in terms of appearance and manufacturing potential.

Both the designer and the chemist worked on the project for three weeks with different foam materials from the same protocol, and identical, similar or different methods.

Identical methods included separately weighing ingredients, then mixing them in different ratios with controlled adjustments to obtain a wide range of samples that showed new potentially interesting results and even avoidable failures.

A similar method was to prepare the mixture in one container and then pour it into a different one. Particularly, the chemist prepared each time the same amount of foam (changing the ingredients ratio but not the total amount of the final compound) and always poured it in the same PLA glass container, as shown in **figure 5**. This is because he had to continue to reproduce and repeat the experiment under the same conditions in order to find the right formulation for the specific functions needed.

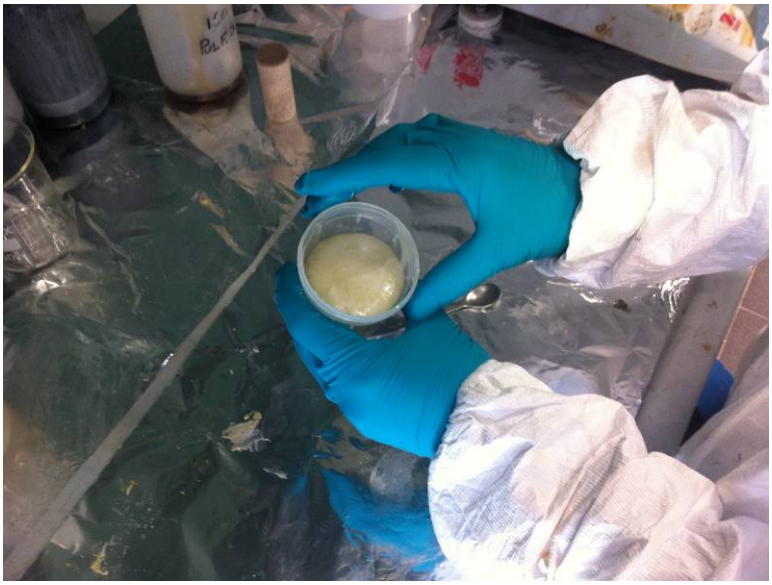

Figure 5. Chemist preparing a sample in a PLA glass.

Meanwhile, the designer prepared different amounts of compound each time according to the size of the surfaces to be covered and poured accordingly it into cylindrical glass forms using different techniques, speeds and movements. Her aim was to obtain different expressions from the same material and to create artefacts in the form of containers using PU coupled with glass, as shown in **figure 6**. One of the techniques was the use of stencils or guides to control the behavior and position of the material.

Figure 6. Designer pouring the foam with different techniques, speed and movements directly on cylindrical basic forms made of glass.

The next step involved completely different processes.

First, the chemist waited for the foam to stabilize inside the PLA glasses. Then, he performed a touch test to discard irrelevant or wrong results. Lastly, he examined the relevant results through the electron microscopy test and moved on to reproduce them to verify their replicability.

The designer, on the other hand, after pouring the selected compound onto the glass forms, carried out a series of hand-crafted operations of shaping and finishing, such as carving with different blades and cutters.

Both parties were intrigued by their respective techniques and results, and the simultaneous work was filled with dialogues and exchanges of views.

As a result of working in a shared space and under a shared protocol, a certain concern and curiosity arose, which led the two different disciplines to engage in a productive dialogue, with mutual listening and understanding.

The designer was more curious about the chemist's choice of ingredients, the quantities and ratios he used, and how this led to his results.

The chemist, on the other hand, was more concerned about the meaning and the motivations of the study.

Step by step, after he learned the critical intentions of the project and the chromatic, structural and formal results obtained, he gradually gained a new interest and personal involvement. He started criticizing, appreciating and advising the designer, who in turn was becoming increasingly familiar with technical-scientific factors. The designer also identified critical points in regard to of lack of human and behavioral factors, which can be followed by speculative and experimental further studies through design.

The real accomplishment of this project was the raising of mutual interest and awareness between two different disciplines. This meets the objective of fostering and training a new generation of researchers and professionals able to deal with complexities through engaged interaction and mutual observation. The role of design artefacts as interfaces to stimulate the interest, curiosity and commitment of science has been demonstrated and validated.

4 Results, discussion and expected outcomes

This research shows how Design is able to adapt and re-imagine its skills and practices to emerging dynamics, to identify critical issues and to generate new points of view and opportunities. It also shows how Design can contribute to the understanding, awareness of modern society.

Specifically, through an analysis of the current material scenario, this work raises some critical questions about the prevailing trends in material research and, instead of seeking answers, draws attention to the need for real interdisciplinary engagement.

In order to pursue effective and critical innovation, the study states the necessity to consider, in every research and innovation process, the highest possible number of factors and variables, including those of a technical and scientific nature, as well as those of a cultural, social and human nature.

A possible experimental and interdisciplinary approach based on practices and methods such as material speculation and research through design is proposed. It was decided to conduct the experimental design activity in a Materials Science lab, setting the conditions for an interdisciplinary debate between Design and Chemistry on the future of synthetic polymers and their replacement with biopolymers.

The designer used a hybrid approach between the two disciplines, where the scientific protocol was guided by critical design objectives and manipulated through design tools and practices such as product concepts, prototypes and handcrafted modeling.

At the end of the project, the designer created some artifacts, shown in **figure 7**, which are the tangible result of a process. The vases/containers created are, therefore, pre-textual objects that incorporate a narrative: on the one hand, their creation introduces a narrative of human and social factors into a natural science lab, thus generating interdisciplinary attention and interest; on the other hand, it takes this narrative out of the lab.

Figure 7. Vases/contenairs crafted as pretextes of discussion about materials issues inside and outside the laboratory.

These objects are intended to stimulate public interest and knowledge on certain topics. They are not meant to provide adequate solutions or directions, but rather to trigger a form of criticism that questions paradigms such as sustainability in an era of confused and disorienting boundaries between natural and artificial, idealism and materialism, sources and resources. This is triggered by their ambiguity, as they are made of synthetic polymers that appear with a new expressiveness that mimics natural materials, such as stone, both in

appearance and in the carving process. They are manufactured using a mixture of chemistry, design and craft.

One of the results of the interdisciplinary interaction process was the extraction of some results of the debate in the operational phase, and new knowledge for further experimental activities.

The value and usefulness of the exchange was evident during the lab session: the designer's raised questions about the technical and procedural factors of the chemist's work, while the chemist was puzzled by the designer's experimental intentions, but also intrigued by her expressive choices, such as the porous structure and the formulated colors, the brilliance obtained through crafting, and the use of glass structures.

The results showed how the knowledge and information exchange between the two different disciplines can 1) facilitate a both quantitative and qualitative type of research; 2) clearly illustrate the specific input of one discipline on a given subject; 3) add several factors to the workspace that deliver a successful result in terms of its impact on society.

Moreover, the comparison showed how other disciplines lack awareness and clarity towards the Design potential, and at the same time proved that it can effectively exploit its tools and skills to inspire interest and curiosity.

This study stresses the importance of identifying and sharing the scientific contribution of Design, and therefore aims to provide specific circumstances for achieving this objective.

To address the objective of increasing public engagement and knowledge outside the lab, all artifacts and materials produced as experimental samples, will be showcased and discussed in forthcoming exhibitions.

The research brings attention to the need to redefine and rebuild a new awareness of the materials that make up our lives, contributing by experimenting and testing ways to enhance reciprocity, mutual professional and human exchange in order to achieve a multifactorial and significant impact on society.

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Design Innovation Strategy for Electric Two-Wheelers in China: A Case Study of NIU Technologies

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The development history of NIU Technologies, an electric two-wheeler (E2W) designer and manufacturer in China, was explored to understand its consideration of the external environment and use of unique design strategies, which enabled it to be listed on NASDAQ in the United States within 4 years of establishment. The company's design innovation strategies were focused on corporate-level business models and market positioning closely integrated with operational-level actions, such as product and service design. The authors believe that the main reason is that the company's founder is a designer and is thus capable of effectively and rapidly responding to changes in the external environment and regulations through a flat, top-down approach, thereby implementing design strategies centered on user needs. Although many of the company's strategies forwent short-term benefits and were clearly different from those of other major E2W brands, they enabled NIU Technologies to meet the needs of the rapidly growing high-end segment of users, transforming the potential disadvantages into advantages and thereby expanding to the international market.

Keywords: startup enterprise; design strategy; market positioning; electric two-wheeler

1 Introduction

The global market of electric two-wheeler is dominated by Asia-Pacific region (Navigant Research, 2016). In recent years, the Asian market has faced fierce competition while some new start-ups with new strategies and new technologies emerged. For example, China had more than 2000 electric two-wheeler (E2W, e.g., e-scooters and e-bikes) companies at its peak in 2013, but fierce competition and increasingly strict regulations have reduced that number to 700 in 2018. However, NIU Technologies, recently established in 2014, was able to get listed on NASDAQ in the United States within 4 years; thus, its business model and design strategies are worth exploring. In particular, Token Hu, the founder of NIU Technologies, has a background in interaction design and worked at Microsoft and Frog Design Shanghai, from which he accumulated rich design experience. He regards design innovation as the core competitive aspect of NIU Technologies, and the e-scooter M1 and e-bike U1 introduced by the company won 7 famous awards including the Red Dot, iF, IDEA,

G-Mark awards etc. since 2017. Accordingly, the use of design strategies to produce advantages during the development process was the topic of focus of this study.

2 External environment and design innovation strategies

New business opportunities often stem from social and demographic changes, technological developments, and changes in policies, regulations, industrial structures (Shane, 2005). The development of strategies often requires consideration of the external environment, and factors from political, economic, social, and technological dimensions have an obvious influence on enterprise strategies and goals (Scholes, Johnson & Whittington, 2002). Regulations governing transportation-related industries are highly strict (Grabowski & Vernon, 2012); thus, external and environmental factors should be considered. Design innovation strategy consists of three levels: (1) corporate-level business model design and market positioning; (2) design department organization and design process strategy; and (3) operational-level actions, such as designing new products and services (Na, Choi, & Harrison, 2017). The authors believe that the three levels can be used as a framework for exploring the design innovation strategy of NIU Technology and its responses to the influences of the external environment.

3 Method

Because few studies have focused on NIU Technologies, qualitative interviews were adopted in this study to understand the status quo of the industry and acquire first-hand information regarding the company, focusing on the research questions of “why” and “how” (Yin, 2003). Additionally, the external environment and industrial transformation were explored through comparison of the interview results with information collected from media reports, such as those by China Network Television (cntv.cn); industry associations; and company websites.

3.1 Interviewees

NIU Technologies’ vice president of design was interviewed to understand the development history of NIU Technologies and the unique design strategy that the company developed. To compare interview data regarding the development process and design strategy of NIU Technologies, other interviewees included the design director of Aima Inc., a conventional large-scale E2W manufacturer, and the supervisor of the Bee Design Company, which helped design and develop E2W models. The interviews were conducted from October 2018 to March 2019.

4 Results

To provide a clearer explanation of the development of NIU Technologies, the external environment before the establishment of the company is summarized as follows, and the history of the company following its establishment is further divided into three periods.

4.1 Background and external environment before the company’s establishment

The external environment, regulations, user needs, and investment environment of NIU Technologies before its establishment are closely related. In 1999, the “General Electric Bicycles—General Technical” stated that e-bikes should not exceed 20 km/h, 40 kg, 240 W, or 48 V in speed, weight, power, or voltage, respectively, and should be equipped with pedals. However, most e-bikes do not comply with the regulations (e.g., they can exceed the

specified speed), and local governments have different speed and weight limits according to industrial development needs (Ruan, Hang, Wang, & Ma, 2012). The China's National Standard for electric motorcycles and electric mopeds-general specifications introduced in 2009 specifies that riding e-scooters requires a driver's license and that e-scooters can travel only in motorcycle lanes. Despite the imperceptible effects of policies and regulations on the e-scooter market, frequent traffic accidents involving e-scooters has resulted in increasingly strict law enforcement, and most cities in China (more than 200 cities) have banned or limited scooter riding, leading to a gradual decline of the e-scooter market (Ruan, Hang, Wang, & Ma, 2012).

In the past, people have perceived e-scooters as cheap, poorly assembled vehicles. Therefore, in 2010 Hu converted a Honda Zoomer into a lithium battery–powered electric vehicle using his own design experience (as shown in Table 1) and then received the praise from his friends and a foreign scooter magazine. He further produced more than 20 units in small batches but was delayed by suppliers and outsourcing manufacturers. Additionally, the theft of his privately owned modified Zoomer in 2012 profoundly influenced Token, leading him to construct factories after found NIU Technologies to meet user needs.

Furthermore, venture capital in China developed rapidly in 2014 (total investment 490.39% greater than that of 2013), providing an opportunity for Token, who lacked funding. He designed a business plan and by presenting clear market gaps and high-quality design attracted both domestic and foreign venture capital (US$50 million in funding), which facilitated his entrepreneurship in 2014.

Table 1 Original modified model

2010 Modified Honda Zoomer		Original frame: Honda Zoomer Range:80-100km Price: N.A.

4.2 Initial period: 2014–2015

4.2.1 External environment and corporate-level design strategy

Before 2014, E2Ws were considered low-cost (US$300–US$600) and low-tech products in China, with common mention of the use of lead–acid batteries and ordinary motors that result in poor endurance and cost reductions by manufacturers to increase competitiveness without integrating intelligent systems (Lin, 2016). NIU Technologies' adopted an opposite approach for its market entrance strategy, which targeted metropolitan young people (particularly men) with high performance and quality standards. The company also incorporated extremely high quality standards (e.g., Bosch motors that accounted for more than 12% of the cost and the lithium battery, which was expensive at the time) into its products, which were sold at a loss (although its selling price was twice that of other brands during the same period). Additionally, NIU Technologies constructed factories (instead of outsourcing) to ensure quality stability. Token, as the company's founder, personally led the research and development and design teams to develop and integrate intelligent systems and in aspects such as product design, software engineering, and data processing.

By 2014, China's Internet and e-commerce platform had matured, forming a complete logistics system, providing convenient electronic payment, and promoting online shopping

habits. During its early days, NIU Technologies adopted an online sales strategy that involved a self-built e-commerce platform, which saves money compared with the typically high cost of opening physical stores while rapidly and effectively spreading the brand's reputation. At this stage, it also attracted market attention through crowdfunding. For example, in 2015, the company launched the N1 model in China on JD.com's crowdfunding platform and raised US$10 million within 15 days, the highest amount ever in such a period.

4.2.2 Operational-level strategies for new product design

Geometric shapes and parallel lines were adopted in the shape of the N1 model to market toward metropolitan male users aged 25–35 years old. In addition to a steel frame of the scooter, plastic casting was adopted to produce a compact design while minimizing fragmented components. Its lithium battery was designed to be easy to extract and charge, weighing only 10 kg, which is 1/4–1/3 of lead–acid batteries with similar performance. A global positioning system (GPS) device was integrated into the central control system to enable users to locate their vehicles using their mobile phones, solving the problem of theft (Table 2). Despite widespread attention during the launching of the N1 e-scooter, the interviewees noted that they still encountered some problems at the time: (1) Regulatory restrictions meant that N1 e-scooters could not be legally used or sold in most cities, (2) Its primary users were young men, meaning the target market remained insufficiently extensive. (3) Online sales growth was slow, and after-sale maintenance was inconvenient.

Table 2 First N1 e-scooter launched in 2015

2015.06 E-scooter N1		Motor: Bosch; Weight: 78.7-84.1kg Power:1.56kw; Range: 100km Size: 1780*690*1149mm; Price:595-740$

4.3 Middle period: 2016–2017 product line expansion

NIU Technologies gradually expanded its product line during 2016 and 2017, and clearly distinguished the market needs of bike and scooter users. This included the launch of the M1 model e-scooter that targeted female users and the design of U1 model could be modified for different purposes. At this stage, NIU Technologies also transitioned to using self-developed motors to reduce its manufacturing costs.

4.3.1 External environment and corporate-level design strategy

NIU Technologies observed the short-distance transportation needs in the city and revealed that many mothers use E2Ws to pick up children at school, and many older adults also use E2Ws for moving. Therefore, NIU Technologies expanded its target market to include female and older users. To improve brand recognition and minimize stock keeping unit management during product line expansion, NIU Technologies launched only three series of E2Ws (N, M, and U series) with different market positioning and developed only one or two new products each year during this period. By contrast, another E2W manufacturer, Aima Inc., develops more than 30 new E2W products each year. Additionally, after observing the slow growth of online sales in 2016 and users' response to inconvenient after-sales maintenance, NIU Technologies adjusted its business model to incorporate simultaneous online and offline sales, acquired additional venture capital, and established physical stores and repair shops throughout China starting in December 2017. This model is the opposite of that adopted by Aima Inc., which focuses on physical stores and commenced online sales in 2017.

Regarding its intelligent systems and core technology applications, NIU Technologies collected big data, which it applied to research and development and marketing. Data transmitted by the 32 sensors on the vehicle could facilitate analysis of the status users riding the vehicles to finely tune vehicle performance (e.g., turning and climbing slopes). Additionally, data transmitted by the GPS could be used to determine the regions with the highest user density to select locations for establishing offline stores. During this stage, NIU Technologies developed its own NIU motors and used Bosch or NIU motors in its N, M, and U series of e-scooters according to pricing, performance, power, and durability to gradually reduce costs.

4.3.2 Operational-level strategies for new product designs

To meet the demand for product line expansion, Carl Liu, another interviewee who is also an industrial designer, was invited by Token to join NIU Technologies as the vice president of design and development in 2016 to lead the development of the M1 e-scooter, which targets the female market. The M1 is smaller and lighter than the N1 and has a lighter and gentler design, with its lines being more chamfered, merging straight lines and round elements. The M1 e-scooter has won many international industrial design awards for its light and fashionable style. Additionally, because of feedback regarding the M1's incapacity to carry two riders, NIU Technologies further developed the M+ model with a slightly larger vehicle and seat.

The U1 e-bike, which can be modified for loading purposes, was designed to be able to be used for carrying children and goods. Its frame design incorporates a thick steel pipe that allows for a load of 160 kg, and 30 modifiable parts were designed to increase its versatility. Additionally, an exposed "naked" frame and mountable pedals and chains were designed for the e-bike to comply with general regulations while meeting user requirements. Table 3 presents the models introduced at this stage.

Table 3 NIU 2016–2017 models

2016.04 E-scooter M1		Motor: Bosh & NIU; Weight: 55.4-59kg Power:0.4-1.2kw; Range: 50-120km Size: 1640*657*1099mm; Price:625-1086$
2017.04 E-bike U1		Motor: NIU; Weight: 50kg Power:0.24-0.5kw; Range: 40-60km Size: 1580*676*990mm; Price:520-610$

4.4 Recent period: 2018

NIU Technologies' strategy in 2018 was characterized by a shift to offline sales as well as the establishment of physical stores and maintenance shops in response to the saturation of online sales. Additionally, the company also targeted development in overseas markets and went public on NASDAQ to enhance its international visibility.

4.4.1 External environment and corporate-level design strategies

The market positioning of NIU Technologies at this phase targeted development in Europe, and the NGT model was developed according to European market needs. The product launch of the new model was held at the Louvre in Paris, an approach that differed from the convention in which E2W manufacturers collaborate with popular celebrities and disseminate

product advertisements via conventional media and the Internet. To expand the brand's international reputation and enhance the confidence of overseas distributors, NIU Technologies went public on NASDAQ. In May 2018, new technical safety specifications for electric bicycles were announced; stipulating that the speed and weight of e-bikes should not exceed 25 km/h and 55 kg, respectively, and that bikes should be operable by pedaling; and are scheduled to be enforced from April 2019. Despite the relatively lenient regulations, most E2W manufacturers are cautious in their product development; however, NIU Technologies redesigned a new UM model in accordance with the new standard.

At this stage, physical offline advertising and marketing could be implemented in regions with more target groups based on the big data accumulated by the intelligent systems. Simultaneously, advertising and marketing in the European market were implemented through online sales (http://shop.econn.eu) and offline sales by local distributors and even through rental services.

4.4.2 Operational-level strategies for new product design

As shown in Table 4, the NGT model, targeted at the European market, was designed with high specifications of quality, size, weight, battery, and endurance, and its frame was as thick as that of a motor vehicle. The 2018 e-bike regulation requires that pedals be installed on the central axis in front of the saddle to facilitate riding, causing a drastic change to the overall structure of e-bikes. A small curved beam frame together with a multicolor plastic molded case was adopted for the UM model, which is substantially different from conventional e-bikes, in which the batteries are exposed directly under the seat. Additionally, because regulations in Guangzhou and Shenzhen stipulate that the weight of e-bikes may not exceed 40 kg, lightweight 6061 aluminum alloy was used for the UM model to reduce its weight to 39 kg to meet the stricter weigh requirements of these two cities. NIU Technologies is the only company that adopts lithium batteries in its entire line of products, thus its large purchase volume of lithium batteries leads to high bargaining power. Although changes in policies and regulations apparently limit the flexibility of the design of e-bikes, NIU Technologies chose to respond rapidly with new design strategies, which turn the regulations into its own competitive advantage.

Table 4 NIU 2018 models

2018.06 E-scooter NGT		Motor: Bosh; Weight:105 kg Power:3kw; Range: 170km Size: 1780* 690*1149mm; Price: 2980$ (in China)-5090$ (in Europe)
2018.06 E-scooter M+		Motor: Bosh & NIU; Weight: 58kg Power:1.2kw; Range: 130km Size: 1725*653.5*1043mm; Price:700-1340$
2018.08 E-bike Um		Motor: Bosh & NIU; Weight:39kg Power:0.5kw; Range: 60km Size: 1598* 729*1051mm; Price: 450-505$

5 Discussion and conclusion

The previous section describes the development history of NIU Technologies from 2014 through 2018, clearly explaining the business model, market positioning, and relevant considerations of the company. Its design strategy focuses more on the corporate-level business model design and market positioning and the operational-level activities mentioned by Na, Choi, & Harrison (2017) and less on the mid-level department organization and design process strategies. The author believe this is primarily because Token, the founder of NIU Technologies, is a designer himself, and is thus capable of quickly responding to changes in the external environment and regulations and effectively linking and developing design strategies through a flat, top-down approach. Carl Liu, who was invited to serve as the vice president of the design department in 2016 to expand the product line, also believes that NIU Technologies is characterized by its consistent overall design strategy. The findings of this study are organized in Figure 1.

Although the company's initial strategy was risky, involving high manufacturing costs and low sales costs, its design concept that focuses on user demands is clearly different from that of other major E2W brands. This concept incudes the introduction of intelligent systems to prevent theft and gather big data that help improve the user experience, sacrificing short-term profits in the pursuit of high quality, building its own factories, and using online sales as a starting point for brand promotionE2Ws are conventionally regarded as low-cost and low-tech products in China, and the needs of the fast growing high-end segment often remain unmet. Therefore, the focus on high quality enabled NIU Technologies to seize market opportunities and respond rapidly, thereby expanding its reach to the international market and turning possible disadvantages into advantages.

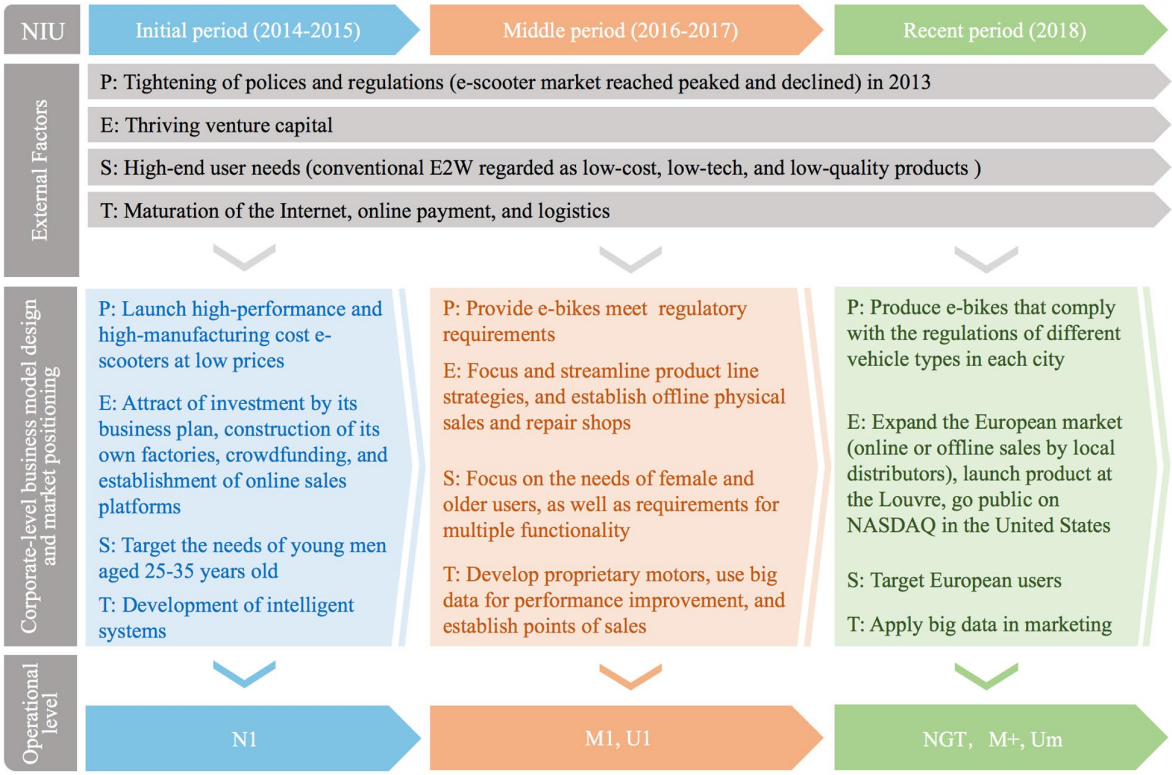

Figure 1. NIU Technologies design innovation strategies

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Embodying Design Practice. Designers' Experience and the Chakra Model

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Experience Design means crafting any form of devices as conditions for and supports to human experience, rather than isolated artefacts. For designers, embodying such approach entails deploying deep sensitivity at all project stages (observation, immersion, experimentation, scenario modelling). This study proposes a practical framework based on a dialog between a phenomenological approach to designers' experience and the metaphoric model of Chakras, coming from the Tantric Buddhist tradition. Notably drawing on pragmatist philosophy and social psychology, it has been applied in an *Experience Design* educational program involving French Masters students. In the article, each of the seven chakras is linked to attitudes and tools used in class, which all work together as an integrative framework to support designers' self-questioning in practice. This crossed investigation aims at drawing a few guidelines to feed designers' approach to *Experience Design* over and above a methodological perspective, putting a strong emphasis on the emotional and bodily dimensions.

Keywords: design practice; experience design; embodiment; chakras

"[In a state of *flow*] the ego falls away. Time flies.
Every action, movement, and thought follows inevitably from the previous one.
Your whole being is involved, and you're using your skills to the utmost."
(Csikszentmihalyi in Geirland, 1996)

Conceptual frame

The Chakra model

Coming from the Tantric tradition, the Chakra model was first described by a Bengali yogi, Purnanda-Swami, in the 16th century text *Sat-Cakra-Nirupana*. Though this chapter was the subject of numerous commentaries through centuries, it was translated only in the early 1900s by a British judge living in India (Woodroffe, 1919/1974). It provides an integrative model describing canals of energy running through the human body, punctuated by six *chakras* that can be viewed as wheels of energy concentration situated along the spine. Nowadays, the popularized map highlights seven chakras, each of them being associated with an area of our mental being and its baggage of stored ideas, experiences and symbols. Chakras may also be linked to physical elements, colours or body organs, symbolizing the attributes of related faculties and emotions. Though the model deploys vertically, no

hierarchy is involved between chakras. They function as a whole system, all states of consciousness conditioning each other. In the Buddhist culture inspired by Tantra, the practice of yoga aims at fine-tuning the chakras and balancing the energy flow in the body. It is not at stake here to discuss the tangible existence of chakras, nor to adopt a mystical viewpoint on the theory and practices attached. The model will rather be used for its holistic and metaphoric properties in a dialog with designers' embodiment in practice.

From experiencing…

It is now widely acknowledged that the "designerly way of thinking" (Archer, 1979) involves a way of tackling complex issues that is not only cognitive but also sensitive, narrative and affective. Most discourses in design research have been focusing on the rational side, for instance by formalizing processes and methods. In contrast with a sequential approach to design based on project staging, this research focuses on *experiencing*, which remains under-investigated. In this line, the experience lived by designers in practice is studied in a phenomenological perspective, notably building on pragmatist philosophy and social psychology, and rooted in the *affective turn* (Clough & Halley, 2007; Gregg & Seigworth, 2010). The approach is not limited to emotional states, rather considering relational modes of being-in-the-world. Experience is hence like "a three notes chord where moves of the body, the mind and the environment momentarily converge" (Rosa, 2016).

In the early 20th century, John Dewey described *aesthetic experience* as full absorption in activity, which intensifies the sense of immediate living. An experience develops over time, in a global movement toward its own consummation. Though determined by a single pervasive quality, it is never exclusively emotional, practical nor intellectual. Consequently, not only artists but also scientists or craftsmen proceeding with care may be equally engaged in such way (Dewey, 1934/2005). Through *emersion,* environmental effects are voluntarily or involuntarily activated in the body, creating sensations that are able to modify self-awareness, during and after experience (Andrieu & Bernard, 2014). The experiencer is hence not reduced to her self but engaged in a relationship blurring the lines between the inside and the outside. This is in line with the concept of *Stimmung* brought by Martin Heidegger to characterize moods arising from ecstatic engagement with the world (Arjakovsky & al., 2013). In the same vein, contemporary sociologist Hartmut Rosa describes *resonance* as interplay between perceiving and receiving. "First, af←fection: we feel truly touched or moved by someone or something we encounter. Affection has an emotional, but also a cognitive and certainly a bodily element. Second, e→motion: we feel that we answer this 'call', we react to it with body and mind, we reach out and touch the other side as well." (Rosa, 2016).

… to *Experience Design*

These theories and concepts provide several teachings for *Experience Design* education. Our research team has built the program described below for Masters students at Strate School of Design (France). We argue for a sensitive approach integrating emotional, affective and relational dimensions over time (Dewey, 1934/2005; Kahneman, 2013; Korzybski, 2007; Schaeffer, 2015), beyond a deterministic perspective to design.

Firstly, since "experiencing like breathing is a rhythm of intakings and outgivings" (Dewey, 1934/2005), an *aesthetic* or *resonant* relation to the world involves conciliating openness and ability to respond. In other words, experiencers would be vibrating as senders and recipients

at the same time (Rosa, 2016). However, people respond to external stimuli in various ways depending on past experience, disposition and life situation. This is a double concern for designers, on the one hand as professionals of "shaping things", on the other hand as humans, themselves potentially affected by any situation. Our educational approach hence builds on symmetry between designers' experience in practice and the one they craft for others.

Secondly, since nothing that is experienced can be isolated from its context, "an experience" cannot be an outcome of the design process, rather a consequence left to experiencers. In this line, artefacts are no ends in themselves but conditions for and supports to human experience. Thus, our project methodology first invites to reformulate the design brief through the filter of people's needs, aspirations and imaginaries (Musso, 2005). An emphasis is then put on analogical thinking (Hofstadter & Sander, 2013) and the investigation of emotional tensions and paradoxes. Contrarily to the classical design process, the outcomes are no "solutions" but *experiential prototypes* given to perform, share and reflect on.

Lastly, design is neither an individualistic practice nor an attempt to master the world, but a means of engaging with oneself and with others. More precisely, *Experience Design* focuses more on posing relevant questions than on finding the right answer. Hence, we argue that design education should less aim at training skilled technicians than at nurturing a mode of being-in-the-world characterized by a deep interest for people and things of the world. In this line, we believe like Hartmut Rosa that "axes of resonance are more likely to appear when departing from established programs to make way for heterodox and unexpected approaches" (Rosa, 2016). The following sections present attitudes and tools used in the *Experience Design* program, in a dialog with the Chakra model. Its metaphoric and holistic properties allow for a non-linear and embodied approach to designers' experience in practice. Though each chakra is studied successively, it should be noted again that there is no hierarchical or sequential relationship between them. In the same way, the attitudes and methodological tools presented all work together as an integrative framework to support designers' self-questioning in practice. The paragraphs below may hence be read in any order, and naturally refer to each other.

1 Root chakra – *"I am"*

Muladhara in Sanskrit. Represents foundation, basic trust and feeling of being grounded.

Research in social sciences and neurophenomenology brought the concept of *blind spot* of psychological experience, the inner place "from which our attention, intention, and action originate when we engage with others and with ourselves" (Flowers & al., 2005). Our actions and interactions are hence never fully determined by rationality but partly shaped by emotional and affective provisions. Designers' choices themselves are subject to irrationality, involving so much that is personal like creativity, personal history, culture, learning style and view of the world (Lawson & Dorst, 2009). This implies that design practice is inevitably subjective. There is no single global vision of a situation, no matter how talented or experienced a designer is.

Leaving behind the comfortable illusion of objective choice is often the first challenge for students. From the early key moment of problem framing until the final defence of a proposition, designers need to dare take stance while showing certain distance from their

own point of view. Projects stemming from highly personal approaches are hence particularly delicate to handle. As the content becomes too emotional, it becomes more and more difficult for designers to make well-considered choices. Combining decision-making ability and sense of being-in-the-world is an exercise which falls within the scope of ethics: *"I act"* means positioning oneself in the professional force field.

Indeed, balancing implication and hindsight is learned through experience – understood as *Erfahrung* or knowledge built from practice, on the long run. Besides, we believe it is an educational duty to accompany the students' self-learning process with reading and questioning grids. To this end, our *Experience Design* curriculum refers to inspirational figures in areas such as radical, critical or speculative design, science, conceptual or performing arts… all bearing strong stance in the profession. By comparison and through critical thinking, students are stimulated to reflect on their own positioning, engagement and potential biases.

2 Sacral chakra – *"I feel"*

Svadhishthana in Sanskrit. Represents creativity, ability to accept others and new experiences.

This reflects the most sensitive side of designers' experience – understood here as *Erlebnis* or phenomenological event. The design process is experiential because rooted in the reality of "third persons", namely the project stakeholders, potential users and direct or indirect audience. But at the same time, designers adopt a "first person" approach that is both cognitive and affective, involving their own imaginary, emotions and intuition. This subjective engagement is not a bias to overcome – since as noted in *"I am"*, the ideal of rational agent is unreachable. The challenge is rather to use sensitivity as a resource in understanding complex situations from inside.

"Becoming sensitive requires taking account of the everyday experience of being. You need to imagine how you circulate yourself "naturally" – with the necessary quotes around that word. […] Things can come to you, but if you don't render yourself sensitive to them, you just don't get it." (Latour, 2016). Though, full immersion in experience is not natural to adults trained to reflect and rationalize. It is hence a challenge in design education to overcome prejudice and self-censorship and dare to venture in the search of peak moments of *flow* as described by Csikszentmihalyi (epitaph). To enhance students' perceptive attention, we included a dance workshop in the *Experience Design* program. They are invited to embody, therefore prototype with their own bodies, concepts like "engaging with", "taking care", "feeling a presence"… Dancing requires letting go of the rational mind to refer directly to the bodily sense. This was called *focusing* by psychotherapist Eugene Gendlin. "Neither in life nor in design we are limited to rearranging the existing, already-formed things and concepts. We can engage the experiential meanings [to] expand the vital roles which they perform." (Gendlin, 1997). In creative practices as well, feeling from inside is a source of knowledge and inspiration, through which happen *insights*. Suddenly, *"I see"*, perceive a situation in a novel way.

Dancing, crafting or drawing are such ways in which "you become what you draw: not in shape but in affect (Berger, 2005)". However, immersion should not become submersion. As noted earlier, a visceral issue – engaging *"I am",* is particularly tricky to handle as a designer. Sensitive projection requires empathy without falling into the trap of hyper emotional

identification, which makes one unable to act with detachment and discernment. The aim is rather to suspend judgment and become "the one who observes, the silent watcher" (Tolle, 1997) as in meditative praxis. Such attitude leads to *"I understand".*

3 Solar plexus chakra – *"I act"*

Manipura in Sanskrit. Represents power, ability to be confident and in control of our lives.

Since the pragmatic turn, it is acknowledged that thinking, feeling and acting are all in the same manner moments of human activity. Hannah Arendt's position on political philosophy enables a parallel with design. She defines *action* as the highest form of our being-in-the-world, characterized by freedom and plurality. Freedom means capacity to take initiative, to start something new, which cannot be expected from what happened before. This is precisely enabled by our plurality. Each individual is capable of acting and relating to others in ways that are unique and distinctive, consequently contributing to a network of actions and relationships that is infinitely complex and unpredictable. According to Arendt (1988), power is the outcome of collective engagement, as human creation expressing a potential, which always remains available to actors. This meets design practice in its embodied and performative dimensions. Designers step in with ideas that must be adapted to both the context (acknowledging plurality) and themselves (exercising freedom). In particular, *Experience Design* has expressly been defined as "oscillating across the axes of critical design, theatrical practices, existential philosophy and the performance of politics" (University of the Underground). Consequently, designers do not deliver self-supporting artefacts but take into account how their propositions will enter into and eventually transform people's life.

More important, there is no independent individual act in design. *Agency* is not a unilateral strategy but a relation of interdependencies – an "experience of resonant effectiveness" (Rosa, 2016). Action is more determined by energies, processes and relations than by any expected result. This is why, before even acting, identifying the stakeholders involved, their respective role, responsibilities and expectations, is required at the start of any project. Trained to systemic thinking, designers are able to map complex systems and force fields, in a manner that is "entirely oriented toward an experimentation in contact with the real" (Deleuze & Guattari, 1980). In this line, designerly ways are more *tactical* than strategic (De Certeau, 1984). Action does never completely follow the rules and processes, leaving space for adaptation and "response-ability" (Haraway, 2008). Tools, be they material or conceptual, are not simply transferable from one project to another. They must be tailor-made, appropriated, adapted, combined or invented case by case. Whereas most classical design methods claim iterations, this is more accurately *itineration* as defined by Gilles Deleuze and Felix Guattari (1990). Such designers are itinerants, preferring step after step anticipation to deterministic prevision. Rather than imposing form on matter, this approach is based on "bringing together materials and combining or redirecting their flow in the anticipation of what might emerge" (Ingold, 2012). Experimentation and prototyping are key means in the process – as detailed in *"I speak"*.

4 Heart chakra – *"I love"*

Anahata in Sanskrit. Represents compassion, sincerity and healing.

Whereas *"I act"* had political implications, *"I love"* represents poetic attributes. Whereas politics means engaging in power relationships, poetics means gathering anyway. Design precisely aims at connecting with people, starting by understanding how they make sense of their world. Human and social sciences, in particular ethnographic research, provide observation and revelation tools that are able to inform design. But "meaningful insights don't come quickly. The process involves slowing down, taking everything in, using all five senses and being curious." (AIGA).

Indeed, several levels of knowledge about human experience may be accessed through different techniques. Following the categories of the empathy map (a tool developed in the agile community to gain insight on customers' expectations), what people say, think, do and feel are as many layers to reveal. On top of the iceberg is explicit knowledge, easily accessed to by interviews or observation. On the contrary, tacit knowledge cannot readily be expressed in words (Polanyi, 1964), though it strongly determines what people experience. Designers can use several tools to build a better understanding and open new spaces, which will then be used for design purposes. For instance, devices such as notebooks, recorders, cameras… may be left to the subjects of study as respectful gifts, in order for them to share personal details in a warm and informal manner. These *cultural probes* help establish a conversation and bring out new perspectives for designers on people's everyday life, their desires and needs. The inventor of the method Bill Gaver recounts a project aiming at increasing the presence of the elderly in their local communities: "The artist–designer approach is openly subjective, only partly guided by any "objective" problem statement. Thus, we were after "inspirational data" with the probes, to stimulate our imaginations rather than define a set of problems. We weren't trying to reach an objective view of the elders' needs through the probes, but instead a more impressionistic account of their beliefs and desires, their aesthetic preferences and cultural concerns." (Gaver & al., 1999).

Probes may add purpose to projects where the presence of designers might have been downplayed or misunderstood. *Experience Design* students used them for instance to better understand the perceived corporate culture of a luxury brand. The organizational context, characterized by a high level of hierarchy and structure, did not really allow for employees to express their views freely. Designers proposed devices such as a palaver tree, an exchange of correspondence, and even a goldfish, to help releasing the voices with respect and sensitivity. They gained insights on existing rituals and communication issues in the company, as well as on employees' motivation and aspirations.

5 Throat chakra – *"I speak"*

Vishuddha in Sanskrit. Represents ability to communicate and create.

Though design is basically not self-expression, designers share with artists similar sensorial and sensitive expression and communication tools. Whatever the outcome, designing means shaping ideas into tangible forms. In multidisciplinary teams, designers naturally play a translator role, transposing different stakeholders' thoughts into tangible representations functioning as *boundary objects* able to intersect social worlds. In this line, design artefacts perform twofold mediation, both cognitive and social (Star & Griesemer, 1989). This happens through direct experience bringing together perceptive subjects and mediums. Given that different forms can accomplish different feelings, ways of sensitizing (Latour, 2016), designing means fine-tuning the attachment points supporting human experience. Designers

don't write stories but the conditions under which they can begin, as expressed in Marc Hassenzahl's slogan "design *for* experience" (2010). Ultimately, a large part of people's actual experience escapes design intentions. "There is an irreducible gap between the programs and the ways in which they are ultimately received, activated, transformed or simply ignored." (Dominguez Rubio & Fogué, 2014). This humbles designers, who need to receive demonstrations such as opposition, misuse or even hacking of rules as legitimate and significant. For instance, a group of *Experience Design* students working on smart vehicles noticed a paradoxical behaviour, which allowed them to reframe their understanding: though all interviewees systematically used their GPS when driving, most of them admitted (or were caught in the act of) disobeying route suggestions. The effect of presence provided by the device proved to be more valued than its efficiency. This insight provided rich material to experiment new types of interaction.

In an experience-oriented approach, multiple prototypes are necessary to bring complementary perspectives on human experience. Each one is specific, able to enlighten the sensory, spatial, cognitive, social, temporal… qualities of experience. The type we call *experiential prototyping* is especially designed to capture the dynamics and tacit aspects of an interaction, which is difficult in static or inflexible representations. Enactment allows for instance to choreography and explore what "moving" and "being moved" mean to people. Different mediums can be used such as Wizard of Oz systems, spontaneous role-playing, scenes or full-scale environments… They all involve interplay between a "first" and "third person" – described in *"I feel"*, and aim at creating meaning through experiencing – towards *"I understand"*.

6 Third eye chakra – *"I see"*

Ajna in Sanskrit. Represents awareness, ability to focus on and see the big picture.

Making sense of things, integrating disparate elements in a consistent whole are parts of designers' mission. They are expected to deliver propositions that are consistent, both per se and in relation to a context. Following a well-known principle, the sum is greater than its constituent parts. As a corollary, the Gestalt approach also suggests that designerly thinking "originates in holistic sensory-motor-affective experience", not only in the cognitive system. Abstract ideas underlying design originate in "perception, action, the body, and affect" (Lindgaard & Wesselius, 2017).

Metaphors are a source of knowledge developed through physical interaction with the world. They make our experience interpretive and structure our understanding of situations by reference to other phenomena (Lakoff & Johnson, 1980). Donald Schön (1983) highlighted the generative power of metaphors. "Seeing as" opens up novel perspectives on an issue, inviting to reframe or formulate relevant questions rather than to directly answer them. In the same way, *insights* and *analogies* are central to designers' inspiration – the former perceived, the latter rather formed. Many discoveries, inventions and innovations draw on metaphors or analogies. More specifically, they are helpful in *Experience Design* to communicate a meaning, a quality of experience. For example, studying nomadic people and backpackers' relationship to travelling led students to offbeat and engaging propositions for an urban mobility operator. Another example was "seeing" an MRI as a dive or space travel, which allowed another group to understand the key role of preparation and transpose the "instructor" duty in hospitals.

Training to this way of thinking is not simply technical, for instance through the use of matrix. Analogical tools work through subtle transformation in order to capture the essence of inspirational content. Mastering them hence involves sensitivity to feel the deep sense of a metaphor and let insights emerge. Suddenly perceiving a situation in a new way happens when intuition meets a latent potential. By way of metaphor, this is precisely like waiting for Kairos, the ancient Greek figure personifying luck and favourable moments. A tuft of hair hanging over his face allows seizing him when arriving. But the back of his head is bald, meaning when an opportunity is gone it cannot be re-captured (Berger, 2018).

7 Crown chakra – *"I understand"*

Sahasrara in Sanskrit. Represents spirituality and mindfulness.

"I see" inherently conditions *"I understand".* The value of a design proposition is not only rational but also akin to alchemy. In this line, "understanding" doesn't necessarily imply "knowing": it relates to perceiving deep meaning rather than truth. This brings back to inevitable subjectivity in practice – *"I am".* "Seek[ing] to address human aspirations rather than technical problems" (Findeli, 2000), designers are above all concerned by relevance, usefulness and meaning – knowing that this is all relative, never absolute. Therefore, understanding represents the highest level of *experiencing*, a subjective process described in a philosophical perspective about psychology (Gendlin, 1961). It is a flow of feeling occurring in the immediate present and carrying strong implicit meaning. Though experiencing is concrete awareness, it is felt rather than conceptually thought, known or verbalized. This achievement of experiencing is characterized by *felt-sense,* which differs from logic in that it is more intricate and can be conceptualized in a variety of ways: theoretical, creative or narrative… Such meaning is embedded in design projects. Like artists, designers "sensationalize in the strongest sense of the term, transposing in the register of sensation […] analyses which, in the cold rigour of concept and demonstration, would leave the audience indifferent" (Bourdieu, 1994).

If *Experience Design* outcomes preferentially take interactive forms, like performance or role-playing, it is precisely because these mediums open a poetic space blurring the lines between designers and experiencers. Since in a state of *flow* "skills are used to their utmost", experiencing it in practice is a true vehicle for understanding and engaging with others – demonstrating interdependency between *"I feel"*, *"I love"*, and the other areas represented by each chakra. While nearly all aspects of human experience are today unravelled by cognitive psychology, semiology, sensory metrology or neurosciences… a mysterious part of emergence remains. Designers create areas and conditions for experience, leaving space for infinite and polysemous possibilities.

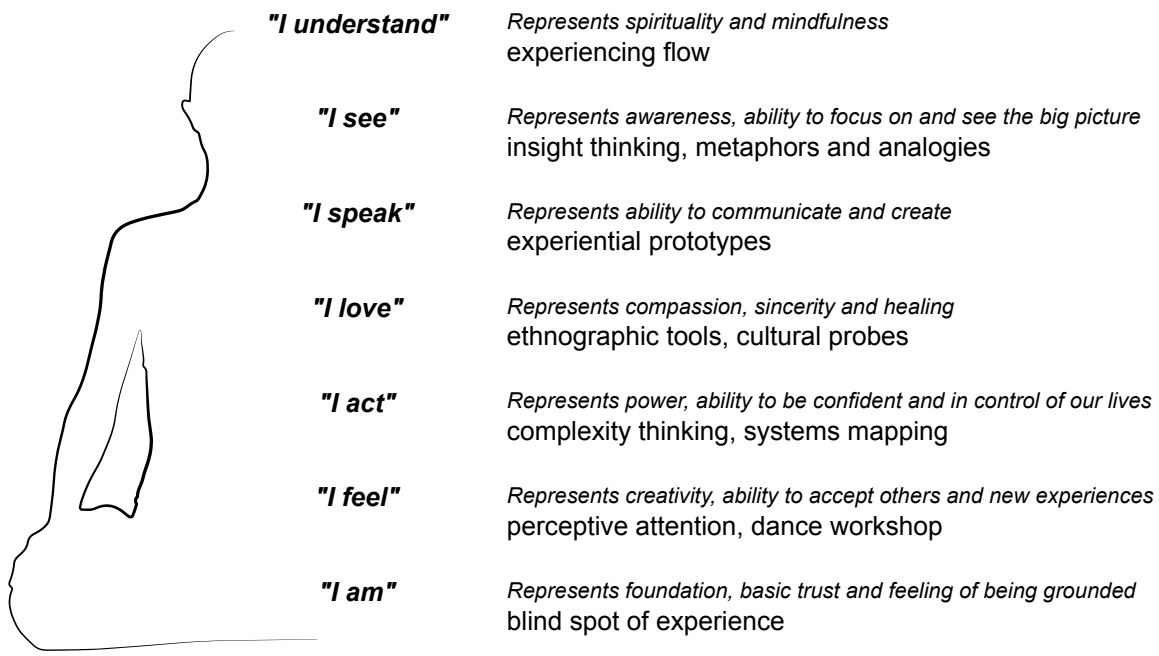

Figure 1. Embodying Design Practice – Experience Design tools in the Chakra model framework

Concluding reflections

> "An experience is something that one comes out of transformed.
> I am an experimenter in the sense that I write in order to change myself
> and in order not to think the same thing as before.
> An experience is always a fiction: it is something that someone fabricates oneself,
> that doesn't exist before and will exist afterward. […]
> The aim [of my work] is […] to experience something that permits a change,
> a transformation of the relationship we have with […] our knowledge."
> (Foucault, 2016).

Though lived in the moment, an *experience* has a transformative power on practitioners. Designers use phenomenological *Erlebnis* to express "what [their] individuality records, like a seismograph, from human phenomenon" (Mendini, [1984] 2014). Over time, *Erfahrung* stratifies expertise that is soft and contextual. Although philosopher, Michel Foucault's intellectual attitude quoted above exemplifies an embodied design approach, characterized by considering work as constantly evolving experience, an extreme relativity of methods, and a reluctance to think of oneself as a knowing subject.

Similarly, the attitudes and tools presented above have no ambition of being exhaustive, and may not be detailed enough for direct pedagogic purposes. The ambition was not to settle any process or method, rather to propose a holistic view of designers' experience in practice, acknowledging its embodied and affective dimensions. The framework drafted here is hence subject to be read, appropriated, refined or contradicted in many ways. We only hope it

stimulates designers' self-questioning. *Cogito*, the experience of thought, "would literally mean to co-agitate, to lead and be led, stir up and be stirred, care and be cared for." (Ingold, 2012). And so would mean the experience of designing, through subtle balance between moving and being moved.

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Exploring How Boundary Objects Can Support Multidisciplinary Design and Science Collaboration

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In order to solve complex issues, professionals from different fields of expertise increasingly collaborate across domains. These collaborations require meaningful and efficient processes, particularly when design approaches and scientific knowledge is combined. Based on the review of existing literature on the role of incidental learning in ideation and boundary objects in multidisciplinary team creativity, it can be proposed that knowledge sharing can support collective creativity. This approach was tested in a preliminary study of a collaborative creative task with pairs of design engineers and bio-scientists. Four pairs were asked to jointly discuss a healthcare-centred innovation brief, and generate novel ideas based on their own expertise. The findings show that boundary objects support knowledge sharing across disciplines in creative collaborations - in this case, design engineering and synthetic biology. While strong role asymmetry was observed, it has been found that boundary objects are instrumental in ensuring both parties participate effectively in the creative session. In the study, designers were found to be steering the conversations by generating boundary objects more frequently than scientists (66% of total number vs. 34%) and sharing knowledge on the design process with them. This initial study will later inform the development of a toolkit that aims to support science and design collaboration process.

Keywords: collaborative design; science; design protocols; boundary objects

1 Introduction

To address ill-defined and complex societal problems, innovators increasingly collaborate across disciplines, combining design approaches and scientific knowledge (Gero, 2000; Sawa, 2016; Schindler, 2015; Simons et al., 2011; Tsekleves et al., 2019) and try to entangle two or more disciplines among art, design, engineering and science (Oxman, 2016; Stark, 2009). However, cross disciplinary collaborations can lead to a lack of mutual understanding between collaborators due to “object worlds” and “thought worlds” presented by boundaries between practices (Bucciarelli, 2003). The context of science and design collaboration can be a rich ground for the generation of creative innovations, but the interactions, methods, processes for such collaboration are yet to be defined (Dunne and Raby, 2013). In this context, this research aims at improving collaborations in multidisciplinary innovation teams and at understanding how to cross boundaries between disciplines such as design and science.

In this paper, a review of existing literature on the role of incidental learning in creative processes and exploration about the role of boundary objects in multidisciplinary teams is carried out. This is followed by a proposed approach for leveraging collective creativity through knowledge sharing. Ultimately, a preliminary study on knowledge sharing in collective ideation is explained. An analysis how boundary objects support knowledge sharing across disciplines – in this study, between design engineering and synthetic biology creative collaborations, concludes the findings.

2 Literature review

2.1 Creativity in Multidisciplinary Collaboration

Every advancement in humankind has resulted from creativity (Sternberg and Kaufman, 2018). Similarly, creativity is a key element for innovation in teams (Amabile, 1988). This study is concerned about exploring ways of enhancing creativity defined as “the production of novel and appropriate ideas” (Crilly and Cardoso, 2017) and as a process by which an agent uses its ability to generate ideas, solutions or products that are novel and valuable (Sarkar and Chakrabarti, 2008). Design studies generally examine external creativity triggers and fixation in the context of problem solving design tasks (Vasconcelos and Crilly, 2016). In a similar manner, scholars assume creativity can be triggered to tackle wicked problems (Rittel and Webber, 1973) and to innovate. However, in this context, the approach requires focus on intrinsic triggers of creativity (Amabile, 1988) and emphasis on incidental situated learning (Lave and Wenger, 1991).

2.2 Learning in Conceptual Ideation Phase

The first studies of creativity describe a process in four phases, preparation, incubation, illumination and verification (Wallas, 1926), and suggest that unconscious factors have a crucial role in the creativity process. More recent studies on idea generation propose that ideas originate from the knowledge base of a practitioner, which is explained in SIAM Model (Search for Ideas in Associative Memory) (Rietzschel et al., 2007). The model also suggests that creativity can be enhanced by inducing people to leave the path of least resistance by increasing depth and breadth of the process. This in essence is the core of any multidisciplinary collaboration because it stimulates and expands the knowledge base of practitioners through a process which stretches boundaries between different knowledge spaces (Drach-Zahavy and Somech, 2001; Oxman, 2016). When developing innovations, the task is essentially complex and multifaceted, therefore it requires an element of mutual learning and co-doing, before truly novel and appropriate ideas are likely to be achieved (Amabile, 1988). Learning function can be defined as the extent to which team or group members overtly reflect on their objectives, strategies and processes for the purpose of creating a team-level intellectual product that initiates change (Drach-Zahavy and Somech, 2001).

2.3 Four States of Knowledge

When analysing the importance of knowledge in creative processes, such as conceptual design phase in the existing literature, four states of knowledge, that can be leveraged in order to pave a way to innovative ideas have been identified (Figure 1). The first state is the natural knowledge base of the practitioner. In order to expand this state, collective learning-based activities can be conducted. Team learning is a phenomenon related to situated cognition. The theory of situated cognition rejects the assumption that learning is the reception of factual knowledge or information. Instead, it puts forward that learning is a

process of participation in communities of practice, participation that is at first legitimately peripheral, but that increases gradually in engagement and complexity (Lave and Wenger, 1991). This type of learning can be intentional, but is never highly structured, which makes it incidental (Marsick and Watkins, 2001). Informal, also known as incidental, learning is always occurring, with or without the practitioner being aware of it. Marsick and Watkins characterise incidental learning as being integrated with daily routines, triggered by internal or external jolt, not highly conscious, influenced by chance, inductive of reflection and action, linked to learning of others.

As learning grows out of everyday encounters while working and living in a given context, it poses an important perspective for reaching the second knowledge state - upgraded knowledge. According to Christiaans (2002), ideas and creativity in designing originate from the practitioner's knowledge base, and more importantly, upgrading the practitioner's knowledge base within a given domain, will increase the chances of her or him coming up with an idea, that can be characterised as creative (Cross et al., 1992). The third knowledge state enables creation or emergence of a creative idea, by facilitation of preparation, incubation and illumination as described in Wallas' model. The fourth knowledge state proposes the emergence of an innovative idea, based on findings stating that creativity is a key element for innovation in teams or groups of practitioners (Amabile, 1988).

2.4 Boundary Objects in Creative Sessions

In order to innovate, new knowledge ought to be created and effectively shared between practitioners (Cairó Battistutti and Bork, 2017). The main challenge is converting tacit knowledge (described as valuable and highly subjective insights and

intuitions that are difficult to capture and share) to explicit (defined as objective and transferable) (Nonaka and Takeuchi, 1995). This process can be facilitated through methods such as generation of metaphors. This type of knowledge creation and sharing is particularly difficult in communications between actors from domains far apart (Star and Griesemer, 1989) which is especially relevant for collaborations between scientists and designers, because new objects and concepts have different meanings in different domains. A potential way to explore collaborative knowledge creation and sharing, is to focus on boundary objects in context (Balint and Pangaro, 2017). Boundary objects can be described as a means of representing, learning about, and transforming knowledge to resolve the consequences that exist at a given boundary (Carlile, 2002). Furthermore, boundary objects are objects which are both plastic enough to adapt to given needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across domains by enabling translation and transfer of knowledge. The creation and management of boundary objects is a key process in developing and maintaining coherence across intersecting social worlds (Star and Griesemer, 1989) such as collaborations between scientists and designers. However, currently there is little understanding about how designers and scientists concretely generate and use boundary objects to leverage incidental learning.

3 Research Question and Hypothesis

Based on this literature review, a new theoretical approach for leveraging creativity through incidental situated learning (Figure 1) can be proposed. The proposal is a result of finding structure and sequence between phases in creative conceptual elements of a design phase. According to this sequence, the conceptual design phase starts with a natural knowledge

base, and there are steps, that can be taken to reach an innovative idea. The first step is to improve the knowledge base, which can be done by learning. New knowledge acquisition facilitates the emergence of a creative idea, which in turn is a precondition for innovation. This approach is supported by the emerging knowledge on creativity stimulation that emphasises ambiguity and unstructured sources of inspiration (Cheng et al., 2014). These qualities are also known to be preferred by designers when they compare and choose creativity triggers for their process (Kwiatkowska et al., 2014). In this context, the question is about understanding how the creativity process unfolds when, multidisciplinary teams collaborate in a field that is rapidly gaining momentum (Dunne and Raby, 2013). It can be argued that the way practitioners from different disciplines learn from each other is a key to creativity, which in turn is a much-needed quality in innovation-oriented ventures. It is hypothesised that incidental learning can be identified through boundary objects. Inspired by this, a proposal to explore the nature of learning in multidisciplinary context can be formed, by asking: *How does incidental situated learning occur in innovation aimed open-ended collaborations?*

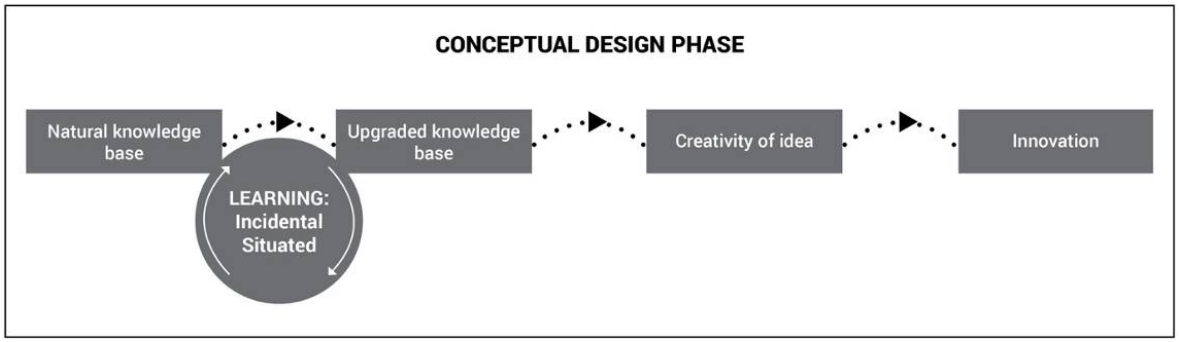

Figure 1 - Hypothetical approach to leverage creativity through knowledge creation

Limitation of this approach is that there are several facets to creativity, which are difficult to control or describe. A study on synergy and team-level creativity describes creativity as the intersection of individual's domain relevant skills, creativity relevant skills, motivation and diversity of the team (Kurtzberg and Amabile, 2001). Similarly, environmental factors can either promote or hinder creativity and innovation. These factors include freedom, appropriate resources, good project management, as well as practitioners' intrinsic motivation and lack of extrinsic constraints (Amabile, 1988). These factors can either work as creativity enhancers or reducers.

It is important to acknowledge, that this study contributes to an understanding about designing *for* creativity (and innovation) by providing a framework that explores the link between incidental situated learning through boundary objects.

4 Experimental Study

4.1 Objective and overview

To understand the effect of boundary objects in collaborations between designers and scientists, 4 ideation sessions were organised. Participants were asked to come up with an innovative (novel and useful) project proposal and illustrate potential outcomes of their proposal. The study entails a qualitative analysis of the use of boundary objects, focusing on how both physical as well as verbal boundary objects help us understand how mutual learning occurs. This is done with the long-term aim of exploring what kind of attempts can

be made to enhance these types of processes, by introducing strategic design interventions that embody a boundary object, or inviting practitioners to create one, as part of the collaboration. In order to leverage the creation of such innovations, the following research questions are proposed:

- How does learning occur in multidisciplinary ideation sessions between designers and scientists?
- What is the significance of boundary objects in 'creative conversations' aiming at innovative ideas (defined as ideas that are novel and useful)?
- What is the effect of boundary objects in multidisciplinary ideation sessions: what positive and negative effects can be identified?

The analysis is contributing to the developing knowledge about understanding the reflective practitioner (Schön, 1991) and co-evolution of ideas in a collaborative multi-agent context. Stompff et al.,(2016) have demonstrated how surprises can be beneficial for inciting reframing in teams. Similarly, this analysis aims to uncover the significance of boundary objects in creative conversations.

4.2 Participants

8 participants were recruited for the purpose of conducting 4 creative sessions with 2 participants in each session - one designer and one scientist (Figure 2). All participants were postgraduate students. Designers were enrolled in MSc/MA Innovation Design Engineering program at Imperial College London / Royal College of Art and scientists were enrolled in MRes Synthetic Biology program or PhD candidates in Synthetic Biology at Imperial College London. Every participant received a compensation for their time. All participants had interest about the domain of the partner they were about to collaborate with. Two participants had previously experienced collaboration between scientist and designer on a relatively brief design-led project. For the purpose of the session, subjects were randomly allocated into pairs (three pairs consisting of male participants and one of female participants).

4.3 Procedure

Participants were informed that the study was about applying their expertise in generating new ideas that can be useful in the future of healthcare domain. Participants were told that there are similar sessions running in the School and outcomes will be evaluated by a committee with potential for selected projects to be awarded or implemented at the college. The evaluation criteria are based on newness and usefulness of proposed solutions, as well as meaningful implementation of participants' own area of expertise in the project.

Phase 1 - Project proposal (45 minutes)

The session is divided into two phases. In the first phase the participants were asked to establish a theme for a hypothetical fully funded design and science collaboration project, which would take place over 6 months. The participants were advised to base the project on ongoing activities and themes currently relevant in their respective departments or related to their study program or research interests. Participants were required to produce a clearly defined title and short rationale for the proposed project by the end of the 45 minutes phase.

Phase 2 - Idea generation (45 minutes)

The participants were asked to generate preliminary ideas or solutions to the project proposal coined in Phase 1. The ideas should aim to illustrate the potential outcomes of the project and usefulness in the healthcare domain.

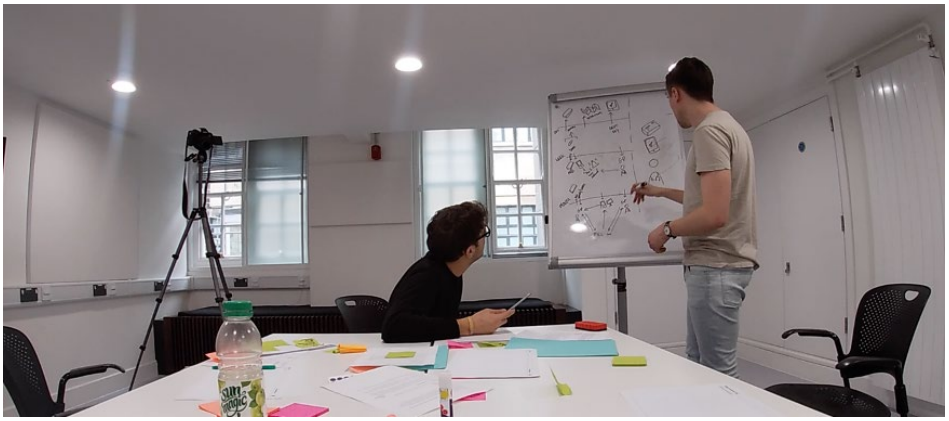

Figure 2 – Experimental setup and discussion about a user journey. Biologist is on the left, designer on the right

All information was represented on printed sheets and in case of questions, they were encouraged to ask the note taking conductor(s) in the room. The following tools were provided: A4 sheets titled: Project Proposal, A4 sheets titled Idea Title, post-it notes, pens, coloured papers, scissors, glue, whiteboard, markers, coloured stickers. The choice of tools is a reflection of conventionally used office supplies in design as well a science meetings.

4.4 Data collection and analysis

All sessions were recorded with two complementary video-cameras. One experimenter took notes during the sessions and interviews that followed. All artefacts produced during the sessions were collected in the end.

Qualitative content analysis is applied to divide text data into explicit categories with the aim to characterise contextual meaning and provide understanding about the nature of the collaboration (Hsieh and Shannon, 2005). The data is first coded by the first author and verified by the second author to ensure reliability. The applied coding process consists of the following steps: firstly, episodes with utterances where co-evolution takes place through learning are identified, which can be identified by an appearance of a boundary object. Secondly, we identify how learning or co-evolution starts by coding the phrases or activities that relate boundary objects. Thirdly, we add our interpretation about the type of boundary object identified next to the quote triggering it. We also aim to measure the time which is spent on being immersed with every boundary object.

The data analysis method is adapted from a study of co-evolution of ideas developed by Reyemen, Dorst and Snelders (McDonnell and Lloyd, 2009). The perspective for analysing the conversations, is to focus on aspects that indicate incidental situated learning through emergence of boundary objects. Similarly to this study, we identify verbal boundary objects in dialogue, predominantly in the form of references and summaries (McDonnell and Lloyd, 2009). These forms of communication indicate increased knowledge levels as well as emergence of mutual understanding regarding the subject under discussion. The qualitative aspect of the analysis reveals patterns and interactions (Clarke and Braun, 2013) that enable an understanding about knowledge sharing as a source of creativity.

In contrast to the study on co-evolution of ideas, where the focus is on identifying verbal boundary objects, physical manifestations of knowledge sharing are also included in this study. In the analysis, boundary objects that are reflected in sketches, drawings, prototypes and process maps are identified (Carlile, 2002) as these phenomena are indicators of

incidental situated learning (Lave and Wenger, 1991). We have expanded the definition of process maps to include storylines, timelines, user journeys etc.

5 Results

5.1 Differentiated designer and scientist roles in collaborative sessions

The task provided in the beginning of the session emphasised the fact that proposals should stem from both designer's and scientist's own area of expertise. Nevertheless, a clear role division between designers and scientists was observed in all sessions. These roles can be summarised as design-explorer and scientist-treasury. This means that in majority of cases and utterances, the designer initiated a way forward in the conversation, by either asking a question or providing a summary or interacting with a boundary object. Concurrently, and due to designers' likelihood of taking the lead in steering the process, a tendency where designers continuously inquire the synthetic biologist about their expertise and approach them as sources of information was observed. In other words, scientists were acting as sources of information. Beyond questioning and answering strategy, tools and methods used in the collaborations were predominantly proposed by designers, who were driving the materialisation of ideas (see table 1).

Table 1. Coding examples of verbal transcripts of the ideation session between a designer and a scientist in session 3.

Start 00:43:38	End 01:27:44	Duration (s)	Quote/description (S) – Scientist (D) – Designer	Interpreted learning indicator (BO_N) – boundary object (R_N) – reframing
00:44:10	00:51:05	415	(D) 'Let's list all the things we talked about'	(BO_1) – list of stakeholders and their needs
00:54:50	00:55:17	27	(S) 'You could do a weird thing…?'	(BO_2) – product use scenario
00:57:44	00:59:44	120	(D) 'Give him a name…'	(BO_3) – persona Stephen/sketch
00:59:44	01:00:04	20	(S) 'There's a company following up on people'	(BO_4) – reference to an existing routine (for service touch points)
01:01:05	01:01:35	30	(D) 'How about personal stuff like an app…alarm clock…'	(BO_5) – service use scenario
01:01:35	01:01:55	20	(D) 'You know, like Monday Socks'	(BO_6) – reference to existing product
01:03:20	01:04:20	60	(D) 'You get it in the post...'	(BO_7) – product/service use scenario
01:05:25	01:05:40	15	(D) 'A month-long egg timer'	(BO_8) – sketch/reference to existing product
01:06:15	01:13:40	445	(D+S) 'Let's look at Stephen's month'	(BO_9) – sketch/timeline
01:13:45	01:14:42	57	(D) 'Let's summarise it'	(BO_{10}) – sketches
01:22:10	01:22:20	10	(D) 'I'm making a pill box'	(BO_{11}) – cardboard prototype

5.2 Boundary objects to record, explain and generate

A divide between the types of boundary objects initiated from designers and scientists was observed. Scientists mostly brought up references to existing products, technologies or research, while designers predominantly initiated boundary objects often associated with design process (Table 2). These include various forms of process maps like user journeys, timelines, personas, diagrams and charts. Generally, the more time practitioners spent on being deeply immersed with a single boundary object, the better the quality of the final idea, in comparison to the number of boundary objects in the discussion. This is the case when the quality of an idea that emerges from the boundary object is subjectively assessed by the authors.

Beyond the type of boundary objects, they can also be divided into three different categories based on their reason for being: to record an idea or milestone in the process, to generate an idea and to explain and externalise existing knowledge to others. These sub-categories in all their forms fall under the definition and rationale of boundary objects discussed earlier, but in addition, leverage the understanding about various boundary objects in collaborations between bio-science and design. To identify the source of a quote or boundary object, the following scheme is used in the analysis: D1-D4 for designers and B1-B4 for boil-scientist, where the number indicates one of the four sessions conducted.

Table 2. Number of boundary objects generated by designers and scientists

Type of Boundary Object	Generated by designer	Generated by scientist	Total count
Post-it note with a new idea	11	3	14
Sketch of a new idea	21	4	25
Reference to existing product, technology or service	19	25	44
Reframing (attempt)	8	1	9
Metaphor	0	1	1
Process map (journeys, timelines, personas etc.)	9	1	10
Prototype	1	0	1
Total	69 **(66%)**	35 **(34%)**	104 **(100%)**

The occurrence of a boundary object varied between different types of boundary objects. Explanatory boundary objects were more likely to emerge in the middle of conversations. These types of boundary objects are often related to participants trying to establish the so-called common ground, and often manifest themselves through references. These references were made about related projects or products in the wider world, for example *'They managed to create an enzyme that could…'* (S1) or *'So, one of my colleagues at… worked with designers, to improve…'* (S4). These types of explanatory boundary objects demonstrated possibilities for solving the task at hand in the collaboration and paved the way for reaching a novel and useful idea. Most often, explanatory boundary objects formed a basis in the conversation and were expressed verbally, but in cases where one or both of the participants found the reference or explanation particularly insightful, it was also captured on a piece of paper (mostly post-it note).

The second type of boundary object observed in the collaboration recorded an element of the overall generative conversation, through writing or sketching. They were applied in the middle of the conversation when the participant(s) considered the shared information useful or relevant enough, for having potential to leverage the ideas. Oftentimes, boundary objects like this, were first expressed verbally, but eventually marked down and triggered by one of the participants announcing that *'I'm just writing down some focus areas'* (D1). Alternatively, boundary objects with the aim to record, can be initiated to summarise a previous episode in the collaboration. In this case, they were identified by either the designer or scientist suggesting making a note of the progress, for example by saying *'Let's list all the things we talked about'* (D3). In this instance, notes were usually made on post-its.

The third type identified in the collaboration was a boundary object which is generative in its nature by inciting a creation of an idea that can be made explicit and shared. Generative boundary objects were often followed by explanatory and recorded ones, which suggests that they appear once the participants feel knowledgeable or competent enough to create and propose solutions that are relatively concrete. Generative boundary objects were usually a physical manifestation of ideas, as opposed to explanatory boundary objects. They were brought to life in various forms, which usually originated in the design domain and related to activities usually embodied in the design process, e.g. *'Should we just jot some ideas for five minutes?'* (D2) or *'Should we write rough ideas on post-its?'* (D2). Generative boundary objects also included user journeys, sketches, personas, scenarios and taking another perspective on the issue at hand, for example *'If we think about the patient's perspective…'* (D3) and *'I'm trying to think about the journey...'* (D4) in conversations between synthetic biologists and designers.

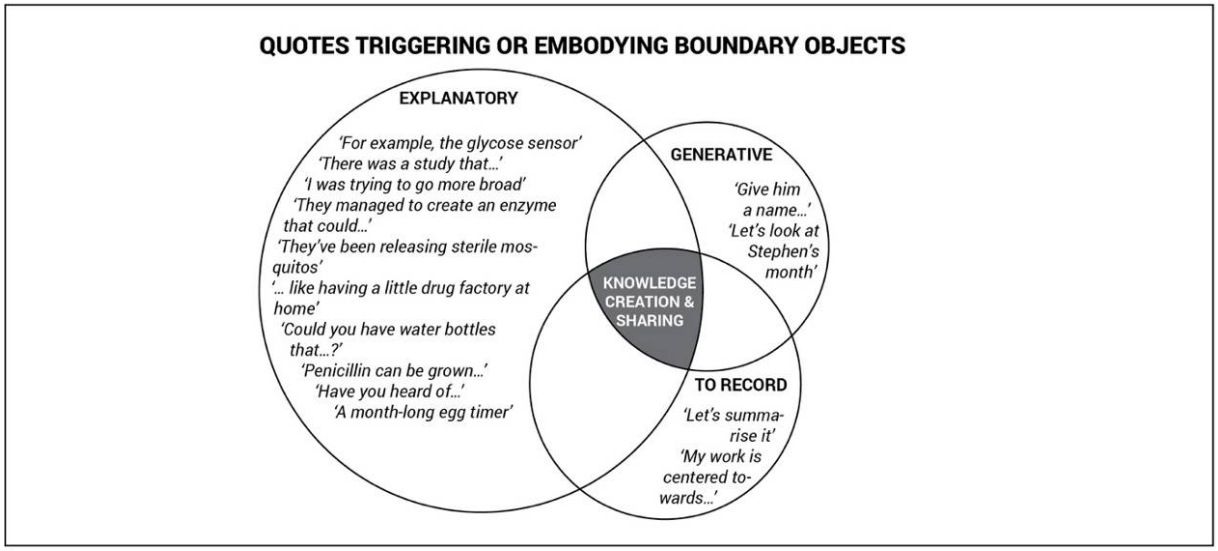

Figure 3 - Selection of quotes from collaborations between synthetic biologists and designer

6 Discussion

6.1 Understanding the role polarisation in design-science collaboration

Beyond the obvious knowledge gap between designers and synthetic biologists, the role polarisation phenomenon may originate from different approaches to leadership and practitioners' previous experiences with steering projects. This may be a reflection on designers being more accustomed to open-ended idea discussions and techniques, whereas synthetic biologists are driven by rigorous research findings.

Comparatively few questions imposed by scientists to designers were observed. Despite this asymmetry, repeated question and answer sessions did not lead to one sided process because ideas themselves originated from designers and scientists collaboratively and indistinctly. This was also acknowledged by participants, for example in session 3 '*This felt like our project…It has met in the middle of our both fields'* (D3), followed by nonverbal confirmation (S3). These roles echo skills that each discipline can mobilise: designers are trained to inquire and probe, but scientists are accustomed to articulate potential research direction from existing literature. This is related to the observation that, in general, designers were driven by hypothetical futures and things that haven't been done before, whereas scientists search for proof of evidence as a precondition for feasibility.

6.2 Effects of boundary objects in multidisciplinary collaboration

Strong positive aspects associated with the use of boundary objects were observed. Most notably, they were instrumental in helping designers and scientist identify common ground. The recurrent use of references from scientists suggest that they were able to adapt the level of their discourse to that of the designers, by describing existing products and possible functionalities. Boundary objects also served as anchor points for both designers and scientists in helping the other understand their way of working. While scientists generally describe the process of research orally and explicitly, designers generally did not talk directly about the design process. However, they indirectly explain the design process through different boundary objects they brought to the collaboration. For example, by introducing boundary objects such as user journeys, designers represented the process and provided guidance for what to discuss next and how to manipulate or formulate a boundary object. For instance, in session 3, the designer introduced a timeline of the user journey (Figure 4). The visual representation of the timeline helped the scientist understand how to participate in the conversation without requiring specific instructions from the designer. It can be assumed that in this case, the materialisation of the process helped scientists position themselves in the design process and actively engage with it. It is a manifestation of incidental learning about the design process. This is significant as designers generally introduce the boundary object by directly demonstrating how to manipulate or use it, for example, by filling the first step in the timeline.

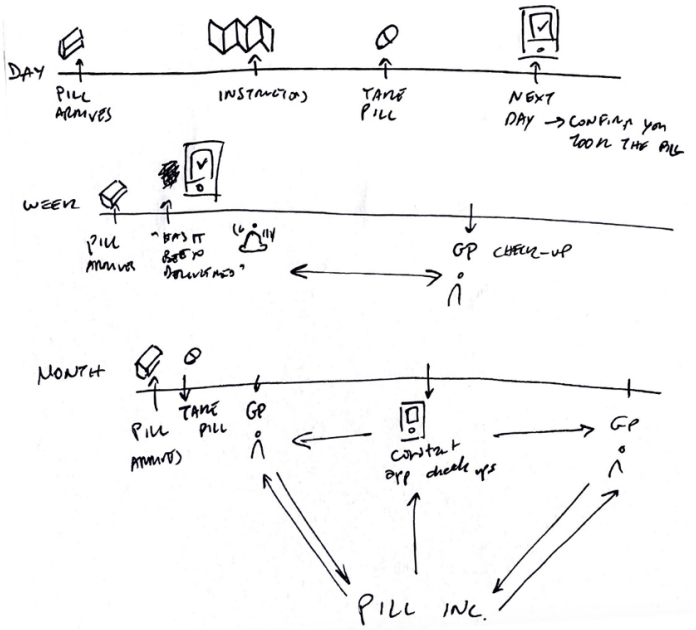

Figure 4 – An example of boundary object - timeline sketch from session 3

Contrarily, potential negative aspect boundary objects brought into the collaborative process, especially early on in the discussion have been identified. To some extent, this can be observed in all conversations and manifests itself as a decision to dedicate the collaboration on one specific application area of synthetic biology before discussing a broader set of potentialities within healthcare domain (as set out in the initial task). In this instance, biosensors or sensing mechanisms regarding illnesses or harmful bacteria became the drivers of the collaboration as observed through utterances such as *'I think it would be best to focus on sensing in our collaboration'* (S1) in minute 13 and *'We use quite a lot of biosensors'* (S2) *'I love the word biosensor…'* (D2) in minute 6. Similar observations regarding decision making process were made in other sessions - *'There are many examples for using biosensors as application for diagnostics'* (S3), four minutes into the discussion. This effect can be described as unconscious focusing on a certain aspect regarding the task being solved, while leaving alternative options. In other words idea fixation (Crilly and Cardoso, 2017) has been identified in the collaborations between designers and synthetic biologists. This can be seen as a cognitive error and associated with low levels of creativity, which makes it consistently unfavourable (Vasconcelos and Crilly, 2016). It is assumed that fixation on one idea during the session is the result of participants being unable to leave the path of least resistance, once they have mutually found an idea that they can both agree on. Given the complexity and difficulties between practices, but also because of the limited time for the session, this may be considered inevitable. However, it can be suggested that efforts should be made to leverage leaving this path, in order to improve collaborations.

7 Conclusion

7.1 Significance of boundary objects in multidisciplinary collaboration

The findings of our study are multifaceted (Figure 5) and emphasise the significance of boundary objects in upgrading practitioner knowledge base, which is a precondition for creativity. This empirical study on collaborative innovation driven sessions combining designers and bio-scientists showed that boundary objects are of crucial importance, when complex information needs to be shared, in order to be meaningfully synthesised into a novel and useful outcome. The analysis has revealed three functions of boundary objects, which can be categorised as generative, explorative and to record. The evolution of ideas and concepts in collaborations relied on learning from one another, and on the ability to creatively form innovative solutions in healthcare domain. We found that boundary objects can be valuable indicators of learning and enable a deep understanding into the dynamics of multidisciplinary collaboration, when practitioners are faced with complex open-ended questions. Boundary objects served as anchor points in conversations, enabling progress. They also facilitated a common ground between practices far away from each other. It may be hypothesised that collaboration between design and science would benefit from tools and processes that purposefully intend to facilitate interactions, which leverage knowledge sharing and mutual learning.

7.2 Ambiguity in learning and role asymmetry

The learning process enabled by boundary objects was ambiguous in nature, which emphasises the benefits of incidental, situated and contextual learning in multidisciplinary innovation-oriented processes. The study found that one of the most valued aspects of the exchange was open-ended nature of collaboration. Ambiguity by design can lead to a pleasant cross disciplinary collaboration for the practitioners, because it offers an experience

of taking responsibility and finding approaches that are meaningful for the individual. Ownership of the problem at hand is related to bottom up approach and it can be suggested that it will aid the creation of meaningful ideas. Based on the experimental study, an implication for a design intervention that aims to improve such collaborations is to acknowledge the likelihood of one-sided interview-like process and to address the need for interactions where all parties and actors from various domains can experience responsibility and involvement.

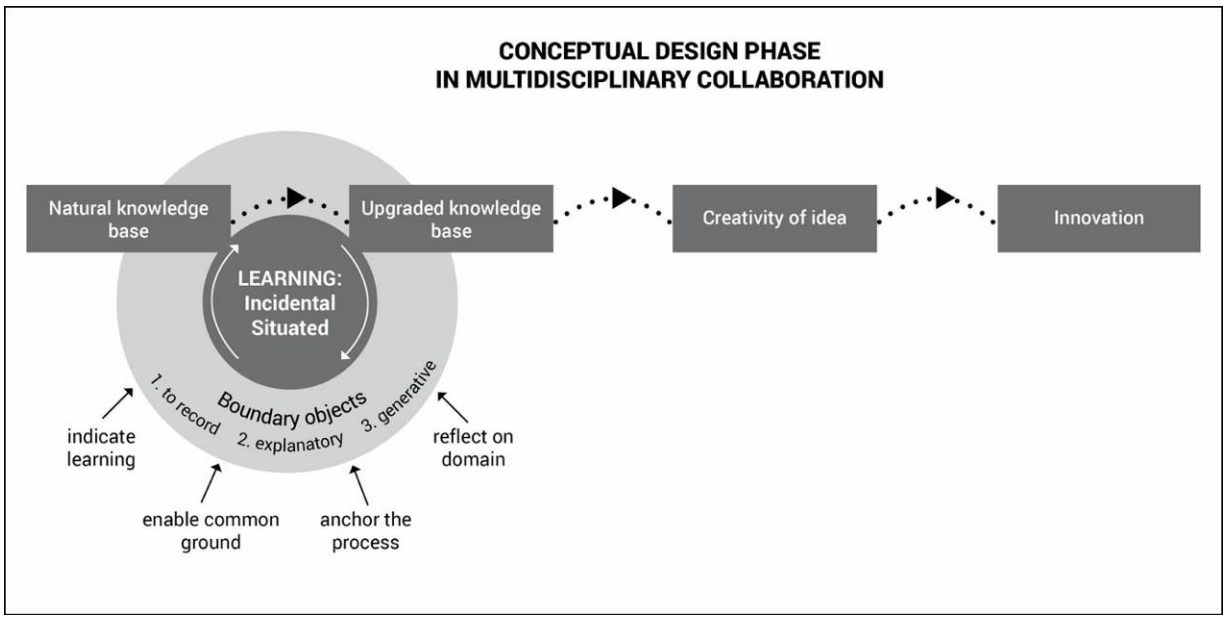

Figure 5 – Effects and types of boundary objects in multidisciplinary collaboration in the context of an approach to leverage creativity through knowledge creation

7.3 Future work

The long-term objective of this research is to understand the correlation between incidental situated learning and creative quality of ideas generated in collaborations. In the next phase, a design intervention will be introduced to the collaboration between designers and scientists. The aim is to assess the impact of the intervention on the creative quality of ideas generated in the collaboration. The expected outcome of the research is a new model of collaborative innovation, supported by a tool(kit), that will support creative conversations between multidisciplinary agents, with a particular focus on designers and scientist. The outcome is aimed to be useful in practice as well as in academia.

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Global Design Researchers Academic Research Mapping from the Perspective of Bibliometrics

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Design discipline has been reborn and developed in the course of multidisciplinary crossover, convection and integration. With the advent of the knowledge networking era, the global design research paradigm actively shifts from experience and theoretical models to data computing thinking. This paper selected 31 international journals as our basic database, using the method of author co-citation analysis from bibliometrics to obtain the knowledge graph of global design researchers. With the help of it, we identified eight research fields of design discipline and high-impact researchers according to total citation frequency. Then we screened out more high-impact researchers from every field, extracting and mapping their original theories in the knowledge graph, which vividly showed the distribution of design research knowledge. Further than that, we take John S. Gero as an example to construct an individual academic research portrait by keyword co-occurrence analysis and literature research, which contributes us to tease out individual research process. Through the above-mentioned analysis of different granularities, we can better understand the core knowledge of design research, the extension of its knowledge and the interaction between them.

Keywords: global design researchers; design discipline structure; researcher portrait; bibliometrics; visualization

1 Introduction

Design discipline has been reborn and developed in the course of multidisciplinary crossover, convection and integration. It has continuously absorbed new ideas, new methods, and new theories from other scientific fields. Its basic kernel has been born in a series of discussions about design research for more than half a century. At the same time, in order to adapt to changing social needs, design science is constantly evolving and transforming itself in the intersection and integration (Lawson & Dorst, 2009). The publication of "Design Expertise" in 2009 marked the beginning of the design study to explore the path of the new research paradigm from following the path of traditional scientific methodology. The academic consensus has reached a trinity design research model: Research About/On Design, Research For Design, and Research Through Design (Jonas, 2007). In the era of knowledge networking, the global design research paradigm actively shifts from experience and theoretical models to data computing thinking.

With the ongoing in-depth cross-discipline innovation in design, the academic achievements of design research output no longer only stay in the domain of practice and innovation, beginning to develop unique academic research and knowledge systems (Cross, 1999). Simon (1996) believes that design is the meta-discipline of all professions. Based on the characteristics of artificial objects, design is concerned with the design process, and it is proposed that design is not an optimal solution, but a satisfactory solution. According to Cross's study (2006) of Designerly Ways of Knowing, the mode of design thinking is the third category of intelligence, which is parallel to the mode of scientific thinking and humanistic thinking. Lawson (2006) advocates that scientific methods and humanistic thoughts should be put under the designer's special design expertise and designer-style mode of thinking, and the comprehensive application beyond subjects should be carried out.

It can be seen that scholars are crucial parts of knowledge production and impartation. Focusing on scholars' knowledge system research can help to conduct interdisciplinary, collaborative, and comprehensive research. This paper aims to explore the disciplinary structure of design through author co-citation analysis, extract core theories contributed by scholars in various fields, draw a map of global design scholars' academic research, further track their respective study history and construct scholars' individual academic research portraits.

2 Structural exploration of design discipline

According to the deep research (Gemser, de Bont, Hekkert, & Friedman, 2012; Nie & Sun, 2017; Gemser & de Bont, 2016) in the text mining analysis of active journals, high-quality journal quality index analysis and journal impact analysis, and publication patterns in design journals, we did the further quality evaluation of these journals. Then combining with our research orientation, expert evaluation, two iterative analyses and verification of co-citation analysis were conducted. Finally, 31 international journals were selected as the source of our research data, as shown in Figure 1. Based on these 31 international journals, we screened out the data published after 2000 to construct the author co-citation knowledge graph because of the characteristics of large proportion and high timeliness. Furthermore, in order to balance the number of literatures in respective research fields, we filtered the original data of ergonomics field and human-computer interaction field, which had overwhelming advantages in the size of the raw data. And we selected 900 literature data from each field to achieve an optimized database.

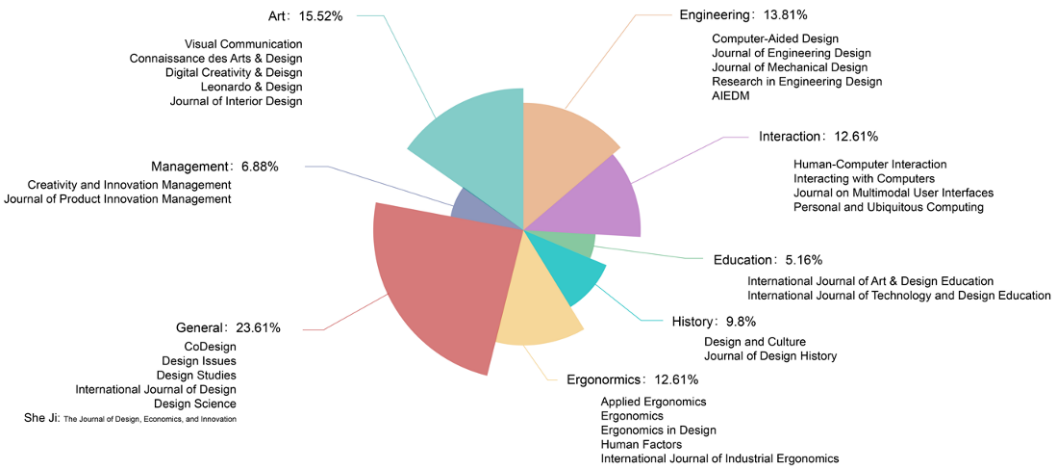

Figure 1. The Source of Data

The content of this paper relied on VOSviewer for data analysis and visualization. Based on the SLM (Smart Local Moving) algorithm, VOSviewer uses the Majorized algorithm for the layout of nodes, which can effectively represent the relative position of each data in two-dimensional space and reflect the inherent logical relationship and hierarchical structure of the data. It is more suitable for presenting the main information of large-scale sample data sets (Liao, 2011).

Due to the authors co-citation analysis can reflect the disciplinary structure and characteristics of the scientific system on a macro level, and it is possible to explain the interactions and dependencies among disciplines from the micro level (Chen & Wang, 2017). We used VOSviewer to conduct co-citation analysis of about 8000 journal literature data, selected 1000 scholar nodes to draw, and obtained the author co-citation network, as shown in Figure 2. According to the strength of links between nodes, all scholars' nodes have been clustered into several different groups with respective colors by the software. Then we consulted with field experts, decided to divide nodes into eight research fields, and denominate them as "Design Cognition", "Design History", "Design Art Theory", "Design Education", "Design Engineering", "Human-Computer Interaction", "Ergonomics" and " Design Management ". Essential theories proposed by scholars in these fields can reflect the core knowledge of design research.

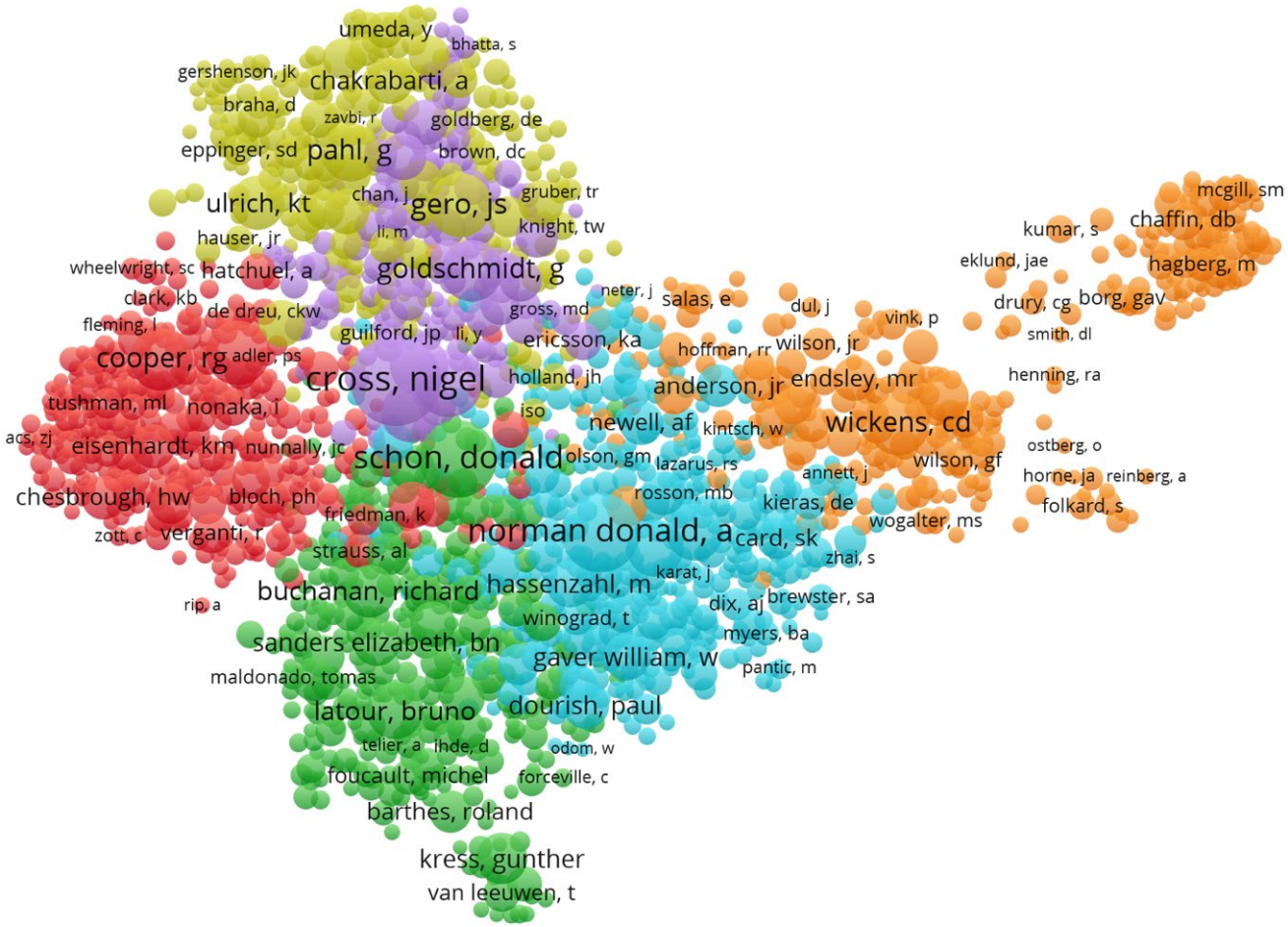

Figure 2. Author Co-Citation Network of Global Design Research

3 The influence of design researchers

3.1 High-impact design researchers

Total citation frequency refers to total citations of the papers published by researchers. It's an important indicator to evaluate the academic influence of a researcher, which reflects the real-name comments of peers on research results worldwide (Wang, Guo & Zhang, 2015). Therefore, through the author co-citation analysis, 20 high-impact researchers with high citation frequency in the global design research field were shown in Figure 3, whose academic contributions in respective fields have promoted the derivation and development of design research.

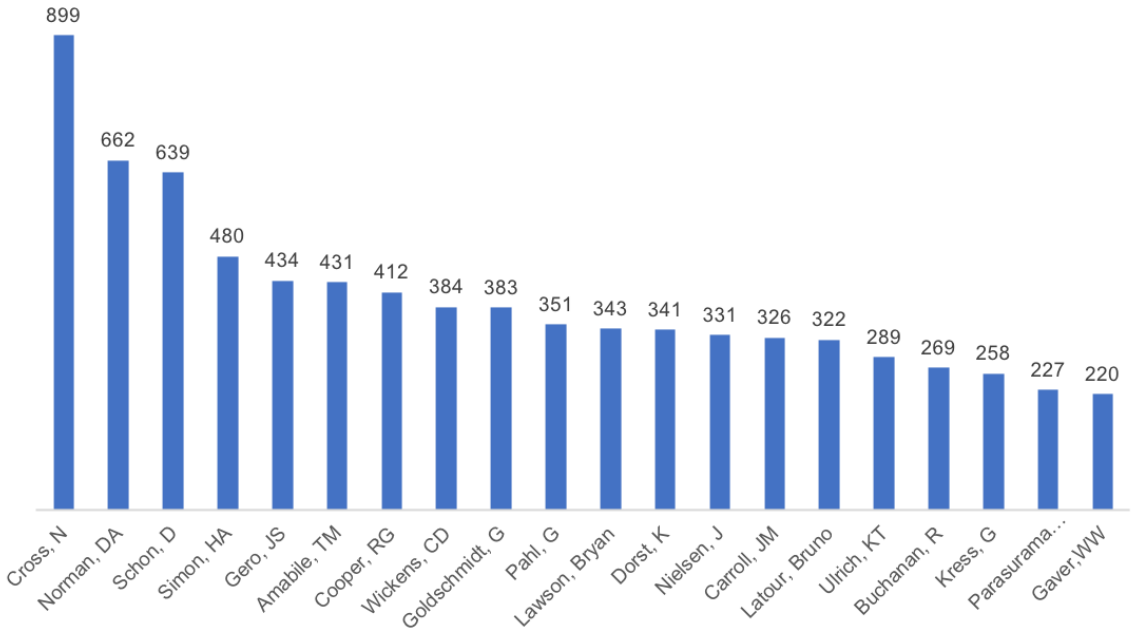

Figure 3. Top 20 High-Impact Design Researchers

Among them, Herbert A. Simon, Nigel Cross, Don Norman, Donald Schon, Teresa M. Amabile and John S. Gero have made significant contributions in fields of design cognition, design education and intelligent design. Herbert A. Simon, as a famous American computer scientist and psychologist, has committed to research intelligent representations in problem-solving and decision-making, and explored the use of computer and artificial intelligence as tools to simulate and enhance human thinking. *The sciences of the artificial* (Simon, 1996) is one of his representative works. Nigel Cross focused on the research in design methods early, and he published *Engineering Design Methods*. Subsequently, his research interests were turned to design cognition and design thinking, and his thoughts in *Designerly ways of knowing* (Cross, 2006) were widely diffused. Concentrated on the research into cognitive science and ergonomics in USA, Don Norman is renowned in the domains of industrial design and interaction design for his book, *The Design of Everyday Things* (Norman, 2013). Donald Schon is a well-known scholar because of the proposal of reflective practitioner theory. He has probed into the nature of the learning system and the significance of learning in a continuously changing society. His paper *The Reflective Practitioner: How professionals think in action* (Schon & DeSanctis, 1986) has obtained the highest citations. Teresa M. Amabile proposed the componential theory of organizational creativity and innovation, which demonstrated the impact of factors, such as internal motivation, working environment, on

individual creativity. Her highly cited article is *Motivating Creativity in Organizations:* On doing what you love and loving what you do (Amabile, 1997).

In addition, Christopher D. Wickens and Gerhard Pahl also play a prominent role in the field of ergonomics. Christopher D. Wickens specializes in the research into application cognition, attention, decision-making, human factors and so on. His interests are mainly taken in the control of aviation vehicles, crossing the intersection of psychology and human factors engineering, interpreting the human behaviour in these complex systems. He has written the book called *Engineering Psychology and Human Performance* (Wickens, Hollands, Banbury, & Parasuraman, 2015), and his high-impact papers consist of *A model for types and levels of human interaction with automation* (Parasuraman, Sheridan, & Wickens, 2000). Gerhard Pahl pays attention to the design process, including computer-aided design, safety and cost issues, modular systems and psychoanalysis of human creativity, whose representative work is *Engineering Design: Systematic Approach* (Pahl & Beitz, 2013).

3.2 Distribution of design researchers from different sub-domains

In order to find out the theoretical cornerstone of design research, this paper analyzed the author co-citation graph and sought for high-impact scholars and their core theories in eight sub-domains of design research, as shown in Figure 4. These authoritative researchers all have significant impacts on design research from various perspectives and levels, whose classical theories constitute the knowledge structure bases and theoretical sources of design research.

In the field of design history, Papanek (1995) presented the design principle of From Cradle to Cradle, which holds that the designer is not only the designer of individual products but also production relationships between the product and the environment. Later Margolin (2002) proposed The Politics of the Artificial, which elaborated on reflective design and multiple ways of engaging in design practices. He also approved of creating an international and interdisciplinary attitude to design research.

In the field of design art theory, there have been quite a few academic achievements such as Actor-Network-Theory (Latour, 2005), Semiological Analysis (Bathers, 1977), Art as Experience (Dewey, 1934) and Metaphors (Lakoff & Johnson, 2008) establishing a solid foundation for the prosperity of design art theories. Different from traditional visual semiotics, The Grammar of Visual Design presented by Kress (1996), concentrates on ‘grammar’, the way in which these depicted people, places, and things are combined into a meaningful whole, rather than on the ‘vocabulary’.

In the field of design education, Buchanan (1998) put forward the Four Orders of Design, including these four perspectives of symbols, physical objects, activities and services, systems, environments and organizations, which inspires educators to rethink the curriculum design of talent cultivation. Besides, the Reflective Practitioner (Schon & DeSanctis, 1986), Social Innovation Design (Manzini, 2015) and Situated Learning (Lave & Wenger, 1991) also have maintained the continuous improvement in the design education system.

In the field of design management, Verganti (2009) raised Design-Driven Innovation, a third way distinct from market-driven or technology-driven. He analysed the essence of design innovation and mentioned the constructive elements of design innovation capabilities. In addition, there are many theories absorbed from management science and other disciplines, such as New Product Portfolio Management (Cooper, Edgett, & Kleinschmidt, 1999), Open Innovation (Chesbrough, 2004), Flow Experience (Csikszentmihalyi, 1996).

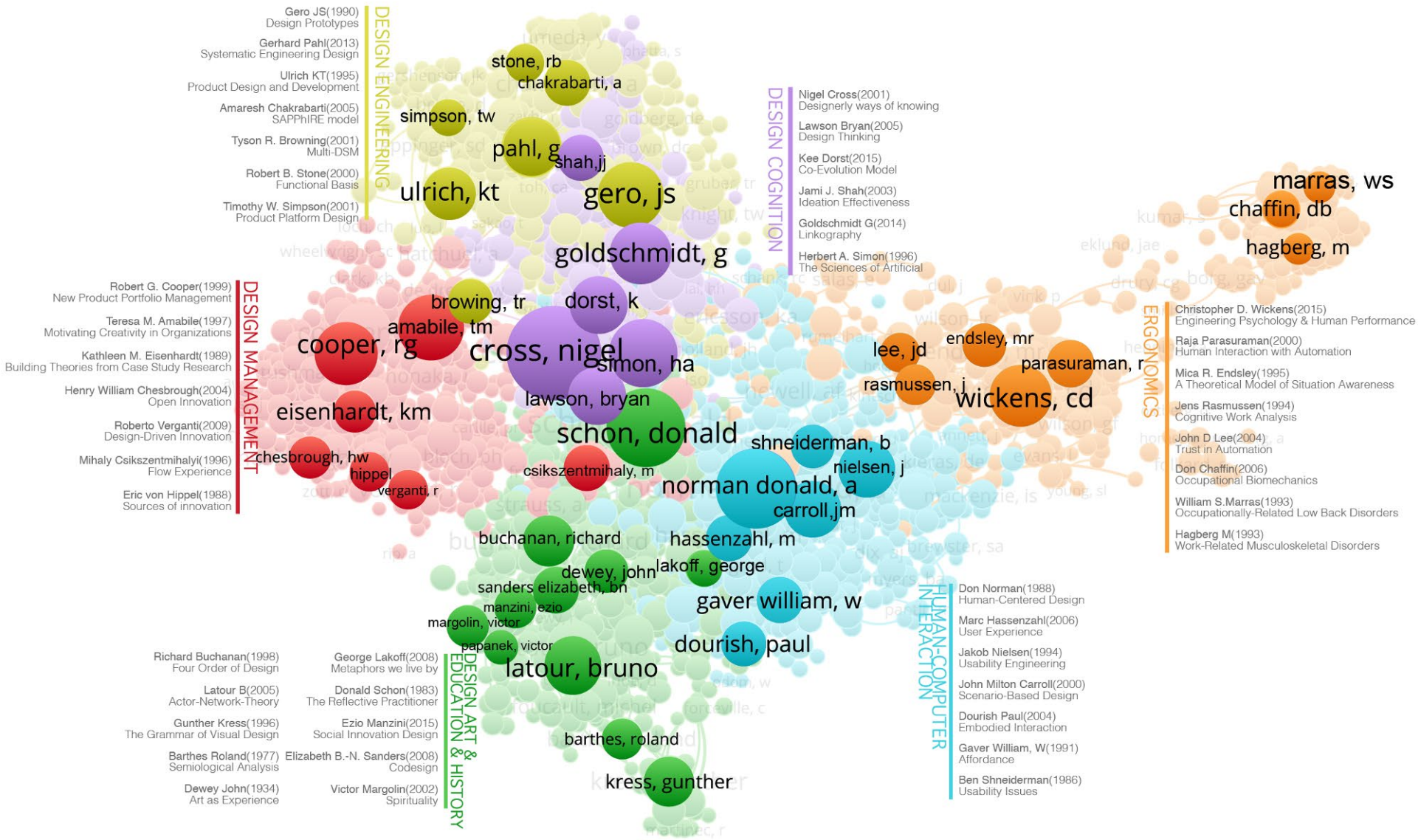

Figure 4. The Theoretical Cornerstone of Design Research

In the field of human-computer interaction, Nielsen (1994) put forward the concept of Usability Engineering, emphasizing user-centered development, which can effectively evaluate and enhance the usability quality of products. Other concepts such as Human-Centered Design (Norman, 1988), User Experience (Hassenzahl & Tractinsky, 2006), Embodied Interaction (Paul, 2004), Technology Affordance (Gaver, 1991) have guided the design practice into further explorations in this field.

In the field of design engineering, Browning (2001) reviewed four applications of the two design structure matrices, static and time-based DSMs, and discussed research directions of the new Multi-DSM. Additionally, Design Prototypes proposed by Gero (1990), Systematic Engineering Design proposed by Pahl (2013) and Product Platform Design proposed by Simpson (2001) have stimulated the optimization and innovation of research methods and product development technology to meet all kinds of requirements of design processes.

In the field of design cognition, Goldschmidt (2014) developed a method for the notation and analysis of the design process, Linkography, which is designed to describe how designers think, generate ideas, put them to the test and combine them into something meaningful. Designerly Ways of Knowing (Cross, 2006), Design Thinking (Lawson, 2006), Co-Evolution Model (Dorst, 2015) and Ideation Effectiveness (Shah, Smith & Varges-Hernandez ,2003) have enriched our cognition of design process and design thinking.

In the field of ergonomics, Parasuraman (2000) created a model for types and levels of Human Interaction with Automation, which provides a framework and an objective basis for deciding which system functions should be automated and to what extent. Engineering Psychology & Human Performance proposed by Wickens (2015), Theoretical Model of Situation Awareness proposed by Endsley (1995), Cognitive Work Analysis proposed by Rasmussen (1994), Occupational Biomechanics proposed by Chaffin (2006) have propelled the research from initial ‘human-machine’ to systematic ‘human-machine-environment’.

3.3 Academic Research Portrait Analysis of Design Researchers

Based on the distribution of researchers in various fields, we further narrowed the granularity of research objects. Different from the traditional citation subjects analyses used to investigate an author’s influence by Wania (2015), and qualitative citation content analyses used to understand an author’s intellectual legacy by Beck & Chiapello (2018), we combined the literature research with keywords co-occurrence analysis, teased out the research processes of individual researchers and constructed the academic research portraits of researchers in a micro level.

In this paper, we take John S. Gero for example, a research professor in computer science and architecture at the University of North Carolina. He conducts extensive design research in the fields of design science, design computing, artificial intelligence, computer-aided design, design cognition and cognitive science. He is also the author or editor of 53 books and over 700 papers and book chapters. His academic achievements have obtained over 20,000 citations with a h-index of 65 and in i10-index of 314. He is on the editorial boards of numerous journals, such as AIEDAM, and the chair of the international conference series *Design Computing and Cognition.*

This paper screened out the literature data of John S. Gero collected in Web of Science, and then imported them into VOSviewer for keywords co-occurrence analysis. As presented in Figure 5, the node in this keywords co-occurrence graph represents a corresponding keyword. The color of the node indicates the average year when the keyword is mentioned

in his literature, the size of node refers to the total frequency of occurrence, and the edge between two nodes means their co-occurrence in the same paper.

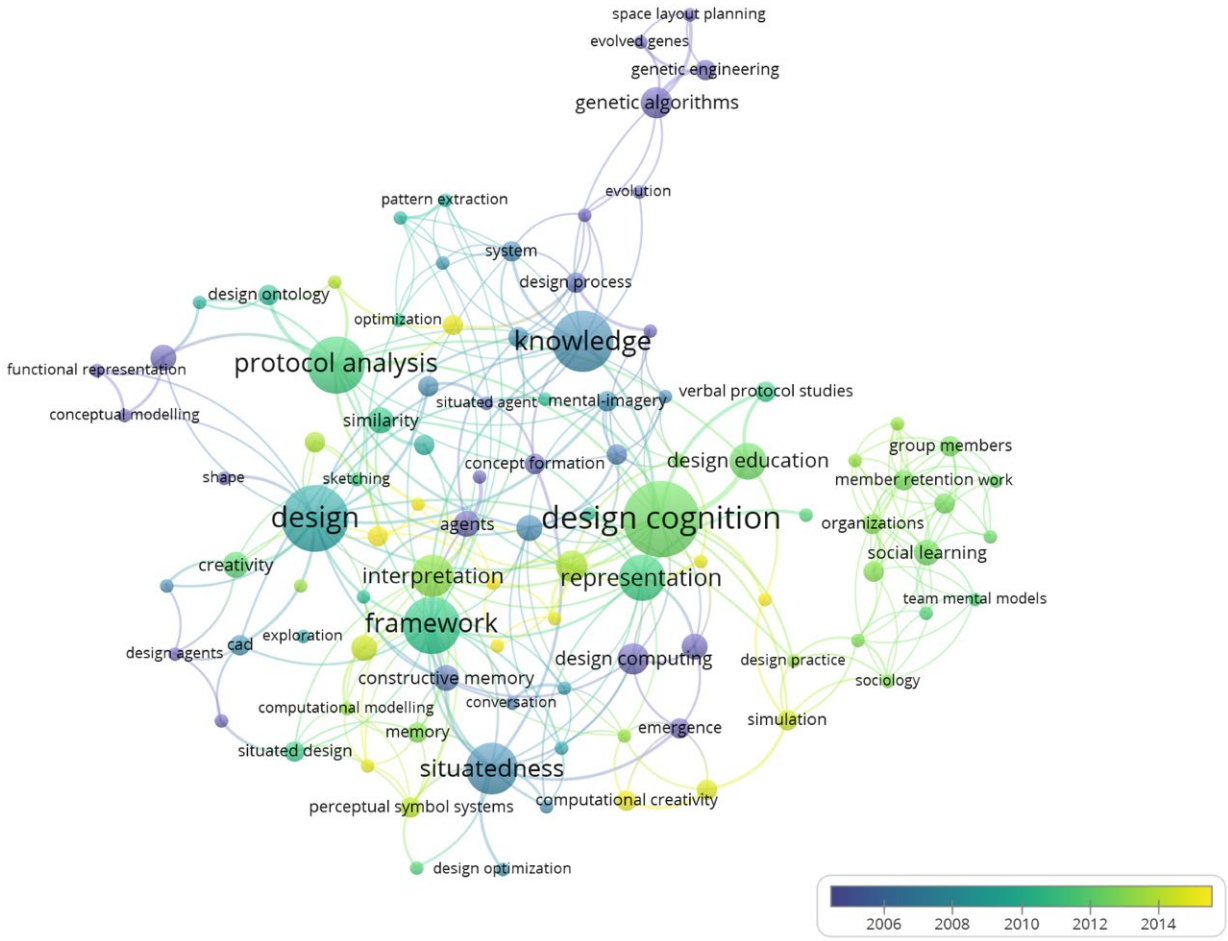

Figure 5. Keywords Co-Occurrence Network of John S. Gero's Research Subjects

Therefore, we interpreted and analyzed keywords shown in Figure 5. It can be identified that he devotes himself to the research into three main fields covering design cognition, design computing and design education. Then we attempted to follow the time sequence to understand the evolution of his research subjects.

From the 1980s to the 1990s, John S. Gero cooperated closely with Coyne RD, Radford AD, Rosenman MA, Murthy NS, Oxman RE and so on. Initially, his research focused on the optimization of computer-aided design, the application of knowledge engineering in computer-aided design, and the optimization of CAD decision-making process. Later, his research began to focus on artificial intelligence in engineering, and he thought that the prototype was the basis of knowledge-based design, and then explored the design creativity applying a prototype method. Subsequently, he introduced a knowledge representation schema for design, called design prototypes in *Design prototypes: a knowledge representation schema for design* (1990). This schema can support the initiation and continuation of the act of designing, and employ design prototypes to distinguish routine, innovative and creative design.

As for the research on design cognition, he worked with Purcell T, Ding L, Tang HH, Smith GJ and other people in the early stage. He began to pay attention to this field in 1997,

proposing a situated agent-based learning method to discover and acquire beneficial knowledge and recognize the situation from multiple representation of the knowledge. Then he (2001) continued to explore the differences between retrospective and concurrent protocols in revealing the process-oriented aspects of the design process. During the years between 2008 and 2012, he conducted diversiform research with his partners including Kannengiesser U, Sosa R, Kan JWT, Saunders R and so on. The contents of his research incorporated information acquisition from the linkography of designers' protocol studies, measurement of cognitive design activity changes during team brainstorming sessions, and design education cognitive research, extended to the fixation and commitment in the design process further, social learning in team and affordance in association-based systems. Since 2018, his interests have turned to the cognitive neuroscience of designing, beginning to utilize quantitative research methods, such as EEG (Electroencephalo-graph), fNIRS (Functional near-infrared spectroscopy) and fMRI (Functional magnetic resonance imaging), to seek for the unique brain behaviours during design processes.

In the field of evolutionary design and function-behaviour-structural model, his research involved the application of genetic algorithm in spatial reasoning, and also discussed the role of function-behaviour-structure model in design. In 2004, John S. Gero and Kannengiesser U extended the FBS framework in *the situated function–behaviour–structure framework*, in conjunction with a model of constructive memory, and proposed a situated functional-behaviour-structural framework. In 2007, they two explored the further application of function-behaviour-structural ontology in design, design objects and design processes.

In general, it is obvious that we can better and faster grasp main research subjects of researchers by applying the keywords co-occurrence method. All of the above results derived from research on researchers form pictorial portraits of their research processes.

4 Conclusion

In this paper, we utilized the method of bibliometrics, and visualization intended to depict an academic research map of global design researchers from several different levels.

Firstly, we screened out 31 international journals of high quality, chose about 8,000 literatures published at the high-credibility period after 2000 as our database. Based on the clear results of network visualization and analyses, it turned out to be reliable and comprehensive, so we will regard it as our standard database and optimize it further.

Secondly, we performed the author co-citation analysis among design researchers, aimed to identify the knowledge structure of design discipline. According to the outcome of cluster analysis, we found that the design discipline consisted of eight fields including design history, design art, design education, design cognition, design engineering, ergonomics, human-computer interaction and design management, which also reflects that design now is characterized by multidisciplinarity after integrating itself with natural and social science.

Thirdly, we pay more attention to every node in the author co-citation network. We elaborated on the high-impact researchers and their achievements and summarized classical theories of prominent researchers from every field. As a result, we found that researchers have played a crucial role in promote the development of design discipline and design education, and their theories laid the core of design knowledge. Based on this paper, we will try to standardize the research system of design discipline from a view of meta knowledge later, which will advance the interdisciplinary design research.

Fourthly, we keep furthering our research into a micro level of one specific author by the same method of bibliometrics. From the keywords co-occurrence graph of John S. Gero's research, we can track his research subject dynamically. Combining with the corresponding literature research, we create his academic portraits through this new way, which can clearly and meticulously depict their research processes.

Fifthly, different from listing the boring literature data by showing the simple information orderly, our visualization results facilitate scholars and students better and easier to understand the situations and distributions of global design research researchers systematically from a macro perspective to a micro one.

At last, we are trying to establish a design scholar knowledge service platform based on methods mentioned in this paper, which aims to help design scholars to acquire knowledge, find cooperative scholars, and understand research trends easily.

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Graphic Design for Learning Chinese Characters: Opinions about Effectiveness and Aesthetics from Audience with and without Chinese Culture Backgrounds

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This study aims to investigate perceptions from audience with and without Chinese culture backgrounds in terms of graphic design for learning Chinese characters from two different angles: effectiveness and aesthetics. The results are used to better inform and improve graphic design for the acquisition of Chinese characters. A structured-interview has been conducted with 10 Chinese Speakers (CS) and 10 Non-Chinese Speakers (NCS) to explore their opinions about graphical variables of design in learning Chinese characters. The result shows differences and similarities of opinions between participants with and without Chinese culture background, in terms of effectiveness and aesthetics. The result is an important contribution for improving graphic design for the acquisition of Chinese characters, moreover, it indicates the future research.

Keywords: graphic design; graphic variables; effectiveness; aesthetics; Chinese characters

1. Introduction

Many researches have confirmed that graphics enhance learning, i.e., Mayer (2009) and Clark et al. (2010). Alongside the fast growth of the Chinese economy, in recent years learning Chinese as a second language has seen an explosive growth around the world. Learning thousands of Chinese characters is one of the hardest parts for foreigners. Graphic design has been chosen as an effective way to tackle this difficult issue for many existing learning materials, i.e. *Chineasy* (Shaolan, 2014, 2016). However, the graphical variables in the learning materials influence its effectiveness (Clark et al., 2010). Graphic design for learning Chinese characters as total beginners is an intercultural research study. Complete beginners are not normally familiar with Chinese culture, while the design team for these materials tend to be familiar with that culture. Do people with different cultural backgrounds have different perceptions with graphics for learning Chinese characters? Do people have different perceptions, in terms of effective learning and aesthetic appeal? How do these perceptions inform graphic design for learning Chinese characters? The literature on related questions reviewed as follow.

2. Literature Review

According to Tyler (1992), aesthetic sensibility and effective communication to an audience are both evaluation criteria for graphic design work. For graphics in learning materials, the effectiveness of learning should be considered as the priority, rather than aesthetic appeal. However, it has been pointed out that graphic designers in some cases overemphasise the importance of aesthetics rather than effective communication, which is more crucial to a high-quality of graphic design (Frascara, 2006). Though Frascara (2006) also states the high importance of "aesthetic appropriateness" (p.31) for instructional graphics, effectiveness is still the priority.

Learner's difference is one of the important factors for effective learning (Clark et al., 2010, Kalyuga & Sweller, 2014). Different culture backgrounds might result in different understanding of graphics. But graphic design used appropriately with consideration could cross boundaries of various cultures. (Horton, 1993). McAnany and McAnany (2009) suggest to use global graphics into instructional design to the international audience. Grove (1989) suggests that international symbols is abstract enough which will not be misleading to an international audience. Regarding aesthetics, people with different culture backgrounds have general principles of aesthetic pleasure, which does not deny the differences between individuals (Hekkert, 2006; Kant, 1952). For effective learning, illustrations have been widely reported as an effective approach for memorising and understanding (Ainsworth, 1999, 2006; Dretzke, 1993). Colour-coding has been suggested as an effective approach to enhance learning and memorising (Chandler et al., 1992; Keller et al., 2006; Smallman et al., 1993).

To explore high-quality learning approaches and to better inform design and strategy, graphic designers are suggested to have active conversations with their targeted audience (Frascara, 2006), thus, a structured-interview has been conducted to further investigate the role of graphic design for learning Chinese characters.

3. Research Methods

To investigate the opinions of different learners (international students and Chinese native students), the structured-interview had been conducted with 10 Non-Chinese Speakers (NCS) and 10 Chinese Speakers (CS). To give critical evaluation and design thinking about instructional design for the acquisition of Chinese characters, it is identified the following points as the main analysis questions to be investigated:

- **Question 1**: Aesthetics appeal or effective learning, which is the priority for choosing Chinese character learning materials with instructional graphics?
- **Question 2**: What are the differences and similarities of opinions between NCS and CS about the graphical variables in terms of aesthetic appeal and effective learning?
- **Question 3**: What are the differences and similarities of opinions between aesthetic appeal and ease of learning for the graphical variables?

Focused on the acquisition of Chinese characters, by looking at 11 books, 2 websites and 2 Apps (Appendix), 6 general graphical variables (details in 3.2) with illustration, colour and typeface have been found. Participants were asked to rank the graphical variables with picture examples from existing learning materials, from easy-to-learn to difficult-to-learn and from aesthetic-appeal to less-aesthetic-appeal. Rank ordering has been suggested as an

important research methodology in terms of preferences (Palmer, Schloss, & Sammartino, 2013). Then, a Likert Scale question was followed to ask their opinions of priority when they choose Chinese character learning materials with instructional graphics.

3.1. Participant

A total of 20 participants were recruited at the University of Leeds, UK. They were all adults (18+) with a mean age of 28 years. There are 10 NCS and 10 CS participants. The 10 NCS participants come from 5 countries: 60% Britain, 10% America (USA), 10% Malta, 10% Brazil and 10% the Netherlands. In other words, they all used a Latin-based or Latin influenced language as their mother tongues, which is an important parameter of their cultural backgrounds.

3.2. Materials and Procedure

Based on the survey of existing learning materials (Appendix), six general graphics variables in illustration, colour and typeface have been categorised in Table 1.

Table 1: Graphical variables in illustration, colour and typeface.

Illustration	
Q1 Size contrast	A. Small Chinese characters with big illustrations
	B. Big Chinese characters with small illustrations
Q2 Relationships between the illustration and Chinese Character.	A. The illustration follows the shape of the Chinese character and the character constitutes the illustration.
	B. The illustration follows the shape of the Chinese character and the character is entirely overlapped upon the illustration.
	C. The illustration follows the shape of the Chinese character and the character and illustration are shown respectively.
	D. The illustration **does not** follow the shape of the Chinese character and the character and illustration are shown respectively. The illustration tells the story behind the character.
Q3 Drawing styles	A. Simple vector
	B. Hand drawing
	C. Silhouette
Q4 Culture background	A. Traditional Chinese elements
	B. International modern elements
Colour	
Q1 Different colour methods	A. Colour-coding on Chinese characters
	B. Colour-coding on the background
	C. Black and white
	D. Original colour
Typeface	
Q1 Different typeface (Figure 1)	A. Heiti Typeface
	B. Kaiti Typeface

Figure 1. A similar example of colour options (Designer: researcher).

All the participants were shown images of Figure 2 in a random order. Figure 2 is a similar example of colour question options which was designed by the researcher due to the copyright issues. All the images shown to the participants are from the existing learning materials. The random order strategy is to avoid participants being influenced by being given the same order. They were shown images with a description of key differences, with A, B, C and D on the reverse (Figure 2). Participants were asked “Which one do you think makes it easier for you to learn Chinese characters. Please rank them from easy to difficult”. Then, all the participants were asked “Which one do you think has more aesthetic appeal to you? Please rank them from the most aesthetic appeal to the least aesthetic appeal.” This process was repeated for the 6 questions with 20 participants. Next, all participants (20) were asked to fill a Likert scale (5-point) to identify the importance of effectiveness and aesthetic appeal in terms of learning Chinese characters. Table 2 shows the Likert Scale questions.

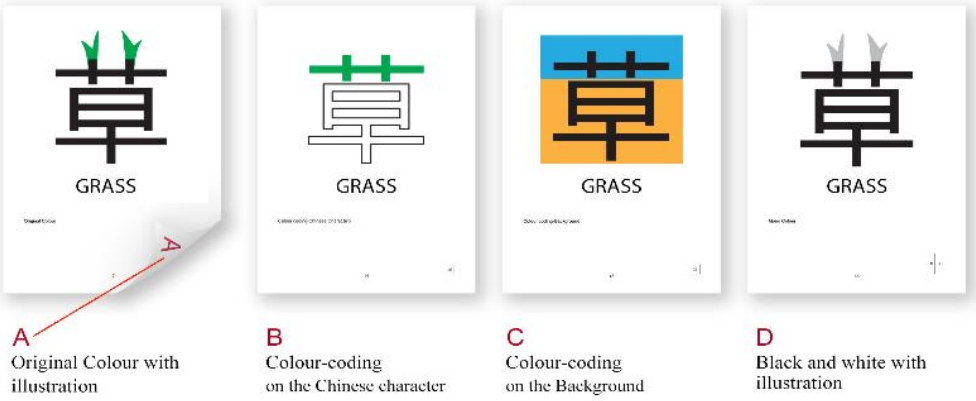

Figure 2. A similar example of colour options (Designer: researcher).

Table 2: Likert Scale questions

When I choose a language learning book, the **EFFECTIVENSS** of learning is the priority.						
Strongly disagree	1	2	3	4	5	Strongly agree
When I choose a language learning book, the **AESTHETIC APPEAL** is the priority.						
Strongly disagree	1	2	3	4	5	Strongly agree

4. Results and Discussion

Regarding the priority comparison between effectiveness and aesthetic appeal in terms of learning Chinese characters, the result of Likert scale questions shows that 90% of participants agreed with the effectiveness as the priority (75% strongly agree and 15% agree), 65% of participants agreed with aesthetics being the priority (5% strongly agree and 60% agree).This is in line with Frascara (2006) who demonstrated that the effectiveness is the priority and aesthetics is the second important factor for graphic design criteria.

For the Aesthetic Appeal, Figure 3 illustrates the percentages of participants who chose the option as the most aesthetically attractive one, data shown in green (left column) is NCS group and magenta (right column) is CS group. In the illustration question group, 100% of NSC group and 60% of CS group chose “big Chinese characters with small illustration”, 90% of NSC group and 40% of CS group chose “The illustration follows the shape of the Chinese character and the character constitutes the illustration”, 90% of NSC group and 50% of CS group chose “Simple vector”, 100% of NSC group and 60% of CS group chose “International modern elements”.

The data shows three trends:

- The opinions of NCS group have relatively consistent opinions, in other words, their preferences are very similar.
- The data of CS group distribution is relatively scattered, namely, they hold various opinions.
- The options which have been chosen as the most aesthetically attractive for both NCS and CS group are the same.

For the first two trends, this might be because the CS group are more familiar with Chinese culture, thus, they might have multiple perspectives of understanding the illustrations which lead to a relatively scattered data distribution. On the contrary, NCS group are less familiar with Chinese culture, thus they have a relatively “single” perception. The last findings and the first two are all consistent with Hekkert (2006) who states that human beings with different backgrounds have a universal aesthetic pleasure but they have differences between individuals.

For the colour and typeface questions, 60% of NCS and 50% of CS chose original colour (option D). The result is in line with Palmer, Schloss and Sammartino (2013) who states that colour preferences are universal across various cultures, though differences exist. There are 80% of NCS and CS that rank Kaiti Typeface (option B) as having more aesthetic appeal than Heiti Typeface, which might be because Kaiti Typeface resembles handwritten Chinese calligraphy, as stated by Dobres, Chahine, Reimer, Gould and Zhao (2016).

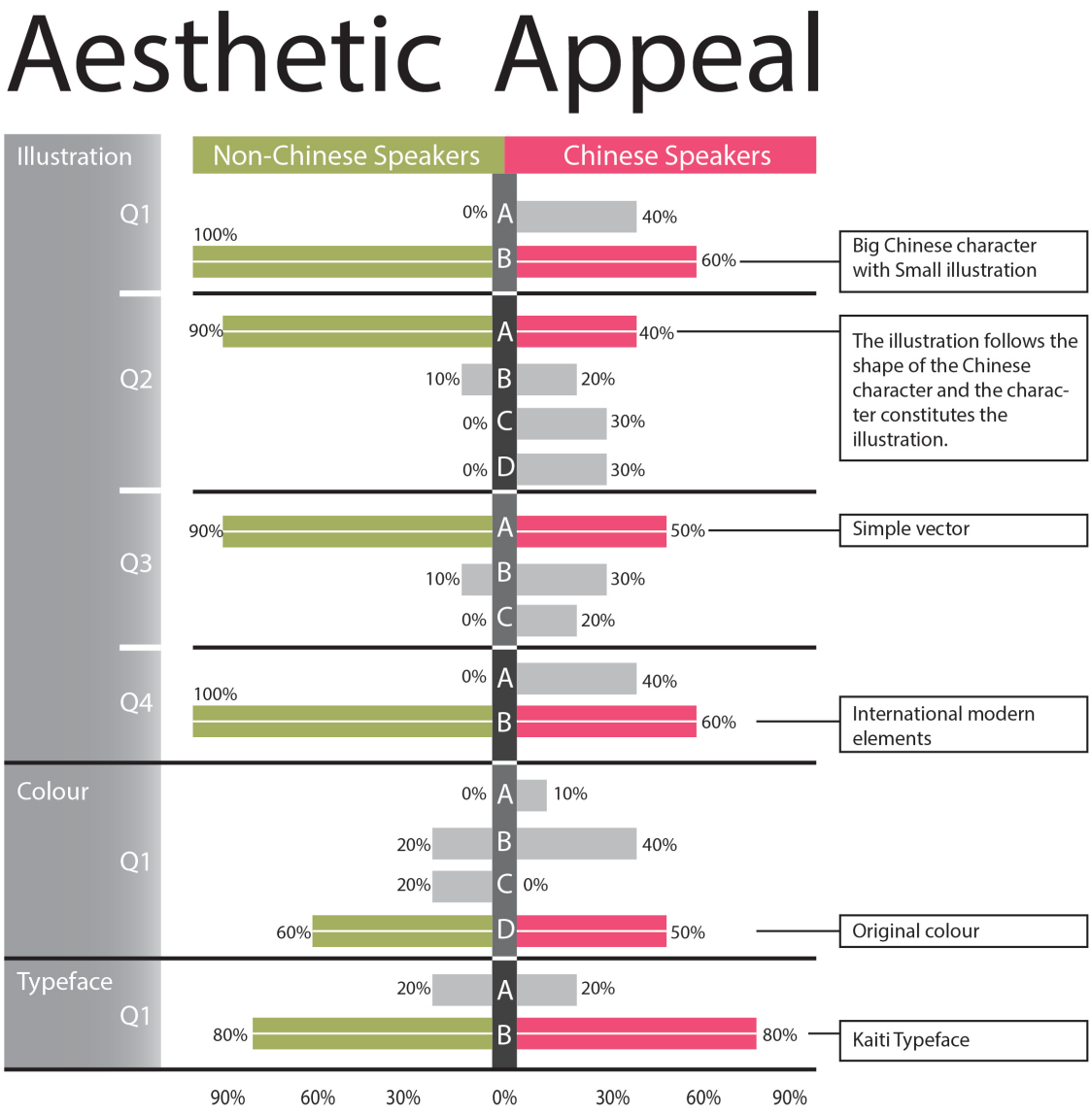

Figure 3. A clustered bar chart to compare opinions of NCS and CS groups in terms of aesthetic appeal

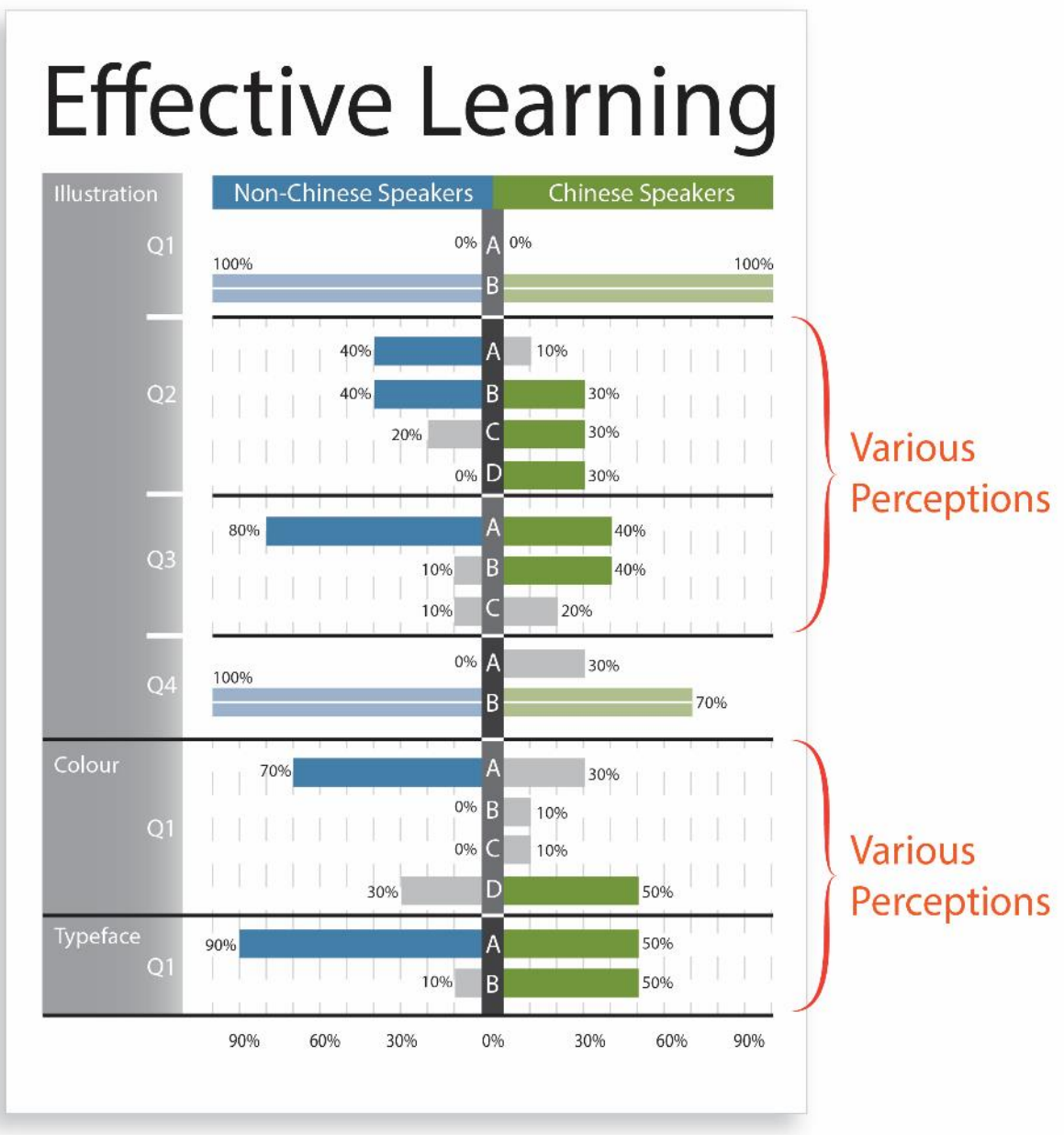

Figure 4. A clustered bar chart to compare opinions of NCS and CS groups in terms of effective learning.

Figure 4 illustrates the results of Effective Learning between NCS group (left column) and CS group (right column). In illustration questions, participants have the same opinions for Q1 (size contrast) and Q4 (culture background). Almost all the participants hold the opinion that big characters with small illustrations (100% of NCS group) and international modern elements (100% of NCS group and 70% of CS group) could bring effective learning. Though some participants (30%) in CS group thought traditional Chinese elements are more close to their own culture understanding. Designers need to pay special attention to this point as not many beginners are familiar with Chinese culture, thus having too traditional Chinese elements might confuse learners. As McAnany (2009) and Grove (1989) suggest to use international graphic elements to cater for international audience.

The orange texts on the right side highlight the various perceptions between NCS and CS group. For illustration questions (Q2/Q3), colour and typeface questions, participants hold

different perceptions from two groups. Participants from two groups hold almost opposite views for option A and D for Q2 (illustration question). For option A, only 10% of CS group rank it as the most effective learning method compared to the other three options, 40% of NCS group made the same choice. This might be because CS group are too familiar with Chinese characters and feel that it's difficult to think of it as a part of an illustration, while NCS group can easily regard Chinese characters as a part of a picture. For option D, none of participants from NCS group thought it is effective, but 30% of CS group found it effective. It is probably because participants from CS group are more curious about the stories behind characters. For the colour question, 70% of NCS group and 30% of CS group chose option A (Colour-coding on Chinese characters), 30% of NCS group and 50% of CS group chose option D (Original colour).This confirms that colour-coding is an effective method to foster learning (Chandler et al., 1992; Keller et al., 2006; Smallman et al., 1993).

For option A, participants who chose it gave the reason that it helps to break down the whole Chinese character into parts and it helps to memorise the position. There were less participants in CS group who chose A, probably because they do not think the composition of Chinese characters is a difficult learning task as they grew up in a Chinese speaking environment. This requires attention by designers that the difficulties of beginners might differ from native speakers' imagination. For the typeface question, 90% of NCS group thought Heiti typeface is more effective than Kaiti typeface, which is in agreement with Zhang (2011) who suggests that Heiti typeface is clearer than Kaiti typeface.

Figure 5 shows the comparison of Aesthetic Appeal and Effective Learning of 20 participants. The interesting and crucial finding is Q1, Q2 and Q3 in the illustration questions, the chosen options are corresponding. Taking the significance of effectiveness and aesthetics into consideration, the best circumstance is the materials having both effectiveness and aesthetics. For other questions, participants have various perceptions in terms of aesthetic appeal and effective learning. For the incompatible options, some have obvious preferences, like 70% of participants thought Heiti typeface is more effective for learning rather than Kaiti typeface, while 80% thought Kaiti has more aesthetic appeal. Heiti typeface will be chosen into design due to the effectiveness of learning and the aesthetic pleasure will be abandoned. However, for colour methods, and relationships between Chinese characters and illustrations, participants have relatively average viewpoint, for example, 50% of participants chose A and 40% chose D for colour question in terms of effective learning, 5% chose A and 55% chose D in terms of aesthetic appeal. In this case, it is better to have an experiment study to compare the effectiveness of learning Chinese characters in further studies.

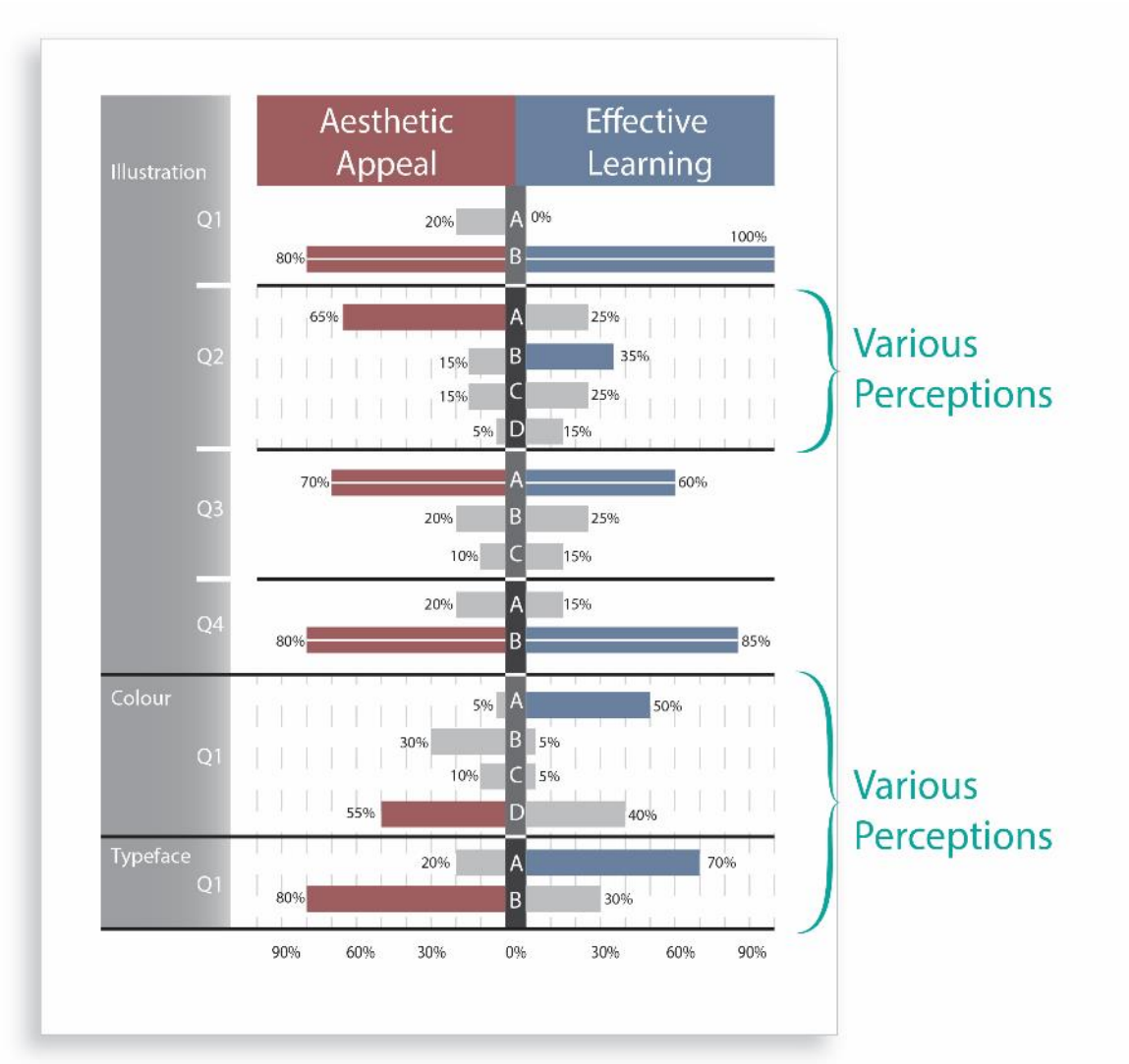

Figure 5. A clustered bar chart to compare opinions of aesthetic appeal and effective learning.

5. Conclusion

This study evaluated different graphical variables for graphics in learning Chinese characters, from aspects of aesthetic appeal and effective learning. Rank ordering as the main research methodology aids research to find the most aesthetic appeal variable and the most effective variable in illustration, colour and typeface. The acquisition of Chinese characters as a second language is a cross culture study, the design objects are Chinese culture related, while the targeted audience are international learners and are mostly not familiar with Chinese culture. Therefore to collect and compare opinions from NCS and CS is crucial to inform and increase graphics for learning Chinese characters as a second language, which is the main contribution of this study. Moreover, this study indicates the future research that colour-coding might be an effective learning method for the acquisition of Chinese characters, which is not widely used and in turn could be further researched.

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7. Appendix

Books	Rowley, M. (1992) Kanji Pict-o-Graphix: Over 1,000 Japanese Kanji and Kana Mnemonics.
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Websites	https://characterpop.com/
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Apps	Zizzle Version 1.67.300
	ChineseSkill Version 6.1.7

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Halletmek: An Inventory of Everyday Design and Production

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Designers tend to follow long processes that may include research, analysis, mind maps, sketches, and models in order to respond to a need or find a solution to a problem. Contrary to these common practices, one can observe users' self-generating solutions with limited means on the streets of Istanbul. Objects are being repaired, adapted or modified in response to a need. Everyday life brings palliative articulations and solutions to even seemingly complex problems. With the belief that design, especially the field of product design needs to pay close attention to such proposals and solutions from everyday life, we have developed a growing inventory of materials and transformational products, and the surrounding culture we labeled as 'halletmek'. Conducting this research from within the design field was crucial for us. Instead of focusing through lenses of social and material culture, our work is rooted in design studies. This we believe is the way we can incorporate these products into design discourse, and thus position the sample of 67 objects we examined (and many more) as design products. Our investigation consists of contextual, material analyses and surveying techniques of production and modification via related documentation and drawing sets. We set aside our judgments and bias in order to take our subject seriously. We positioned certain tendencies and variances on the basis of the collected data and recognized certain patterns during the examination process. We also mapped the distribution of the samples through the city for future reference. Our work through this inventory is a suggestion on how to discuss and make the spontaneous design-production practices visible within the field of product design.

Keywords: product design; methods of making; bricolage; daily life

1 Introduction

Turkish verb *halletmek* is commonly and increasingly used in daily life, in reference to "taking care of things", as a phrase it can refer to solve, to deal with, to set things on track, to fix, to handle, etc. (Halletmek, n.d.).

We observe that in the streets, problems are being taken care of by users in practical and intuitive ways with limited means in the context of Istanbul especially in relation to highly active social and small-scale commercial life. Objects are being repaired, adapted or modified in order to find a solution to an urgent need; things are articulated, fixed, combined, hacked and problems are solved. In this article, we will be examining these practical

solutions and transformative practices encountered in the urban spaces of Istanbul, in contrast to the long and meticulous processes of the design disciplines.

Starting with the idea that the field of product design should look more carefully at the practices of everyday life, we have conducted this research while paying attention to stay within the knowledge base of the design field. Is it possible to think about the contributions and implementations of these ideas and practical details into the design culture by investigating the ‘halletmek’ concept and its examples which have seeped into our everyday lives and to the city? Could designers learn from practical and makeshift solutions of the everyday? What are the ways to critically involve these actions and modes production that are almost contrary to the discipline, within design discourse? Such questions constituted the motivation for our research.

Our investigation is not without precedent. Much has been written on the palliative, the tactical, the ad-hoc, and the every day around the world. ‘Halletmek’ offers an expansion to these discussions, on the one hand, situating a product culture that involves rapid decision and production processes in the case of Istanbul. On the other hand, the ways in which we’ve collected and analyzed the mentioned products and practices propose one possible way of deciphering such practices from within the design field. Our sample of 67 products are studied and positioned with regards to context, materials, and techniques of production, repair, modification utilizing detailed documentation and drawing sets. In this paper, we will touch upon the methods we have used through the research process, how we analyzed the data we have collected, the patterns we have encountered, and the inventory we produced as a result.

2 Situating ‘Halletmek’ and Everyday Practices in Other Geographies

In order to dive into the concept of ‘halletmek’ and to comprehend the main points of these practices, we examined similar concepts from different contexts, cultures and fields. For starters, Claude Levi-Strauss's concept of *bricolage* (1966) and Michel De Certeau's “The Practice of Everyday Life” (2002) are key in positioning users as designers/makers.

French words *bricolage* and *bricoleur* are the most common concepts that allow us to understand the momentary productive capacity of users in everyday life. Lévi-Strauss introduced the concept in his book “The Savage Mind” (1966), which has since been employed not only within the context of anthropology but also in different fields such as critical theory, education, and computer sciences. Oxford University Dictionary defines the word bricolage in the context of art and literature as “construction or creation from a diverse range of available things” (Bricolage, n.d.). In The Savage Mind (1966), Lévi-Strauss explained the concept of bricoleur as the following:

“The ‘bricoleur’ is adept at performing a large number of diverse tasks… His universe of instruments is closed and the rules of his game are always to make do with ‘whatever is at hand’, that is to say with a set of tools and materials which is always finite and is also heterogeneous…” (p.11).

According to Yücel (2010), Levi-Strauss emphasizes that the bricoleur brings together objects previously collected without a certain plan, as far as their ability and the available tools go. He argues that Levi-Strauss “does not undermine the bricoleur or the act of bricolage… yet the limitations of the act and the limits to one’s means is often underlined”

(Yücel, 2010, p. 134-137). Louridas (1999) also mentions that the bricoleur settles with the means at hand or means that are encountered within that moment; and re-defines those means according to the needs of the situation. Bricoleur uses the signs that the objects give; searches his/her material and tool inventory and makes a selection among the possible answers. Yet, this effort is almost never an ideal fit for the needs of the project. From this perspective, the act we refer as 'halletmek' can be strongly associated with the concept of bricolage.

To emphasize the purposeful and goal-oriented nature of bricolage, Jencks and Silver (2013) use the term *ad hoc* which means "for this". They frame the practical *adhocism* as "bringing together various immediate-to hand resources in an effort to satisfy a particular need" (p.110). They see adhocism as a democratic mode of producing, expression of individual needs, styles and environments where the modern modes of production deny plurality of visual styles and personal needs (Jencks and Silver, 2013).

According to Manzini (2015), designing is a skill that we are born with. Diffuse design and expert design -as he called- are two poles of the field of design. Everybody can cook, but not everyone is a professional chef. Everybody can run, but not everybody joins a marathon. As such, everybody can design, but one needs to be trained and extend their "natural design capacity" (p.37) to become expert designers (Manzini, 2015). In his book "Design, When Everybody Designs" (2015), he gives great importance to build strong collaborations between expert designers and diffuse designers to be able to make a transition towards sustainability. Manzini (2015) states that for a sustainable future, not only expert designers should imagine and propose sustainable systems but in collaboration, everybody has to change their everyday lives as diffuse designers.

As a parallel effort to stress the importance of everyday design actions for sustainability, Campbell (2017) uses the term "lay designer" for who "designs without any judgement of inferiority in terms of professionalized knowledge" (p. 30), further defining such examples as "creative and appropriate to their context" (p. 44). He stresses the importance of recognition of these practices and working with lay designers towards more social and sustainable solutions. He also notes that the terms such as bricolage, *jugaad* and so on doesn't always have to indicate favorable results. They always have the risk of destructive, unhealthy, unsafe applications. Designers need to examine these practices with a certain view derived from their profession and acknowledge their potential for a more situated and democratic design practice (Campbell, 2017).

The located and situational nature of bricolage can well be seen from the differentiation of product categories between Campbell's (2017) article and our work. While Campbell's examples are from a rural region of southern Africa, specific to needs of that region and clustered around food, water, shelter and energy; our research was conducted in urban parts of Istanbul concentrated with commercial actions and the objects we encounter are shaped by the needs of urban life such as sitting units, animal shelters, vendor stands.

Similar conditions and practices certainly exist in different contexts and cultures. Campbell (2017) mentions a similar concept to bricolage, *jua kali*. Julier (2017) discusses that such practices are common in developing economies. Similar to *jua kali* from Kenya, he mentions the terms jugaad from India, *gambiarra* from Brazil and *zizhu chuangxin* from China. The jugaad often describes a flexible approach based on problem-solving and using limited

resources in an innovative way in Indian culture (Campbell, 2017; Julier, 2017). Jugaad refers to everyday, small-scale innovations made to interfere with objects in various ways for giving them a second use or provide new functions (Julier, 2017, p. 131).

Rossi (2013) gives a historical account of the practice of bricolage among Italy's Radical Design examples and their influences on Dutch Conceptual Design. From Dalisi's Tecnica Povera and Superstudio to Formafantasma, bricolage manifests as a tool for critique, opposition as well as proposition. Bricolage as a spontaneous action through using found materials with the minimal process was seen as a way of freeing creativity from rigid and alienating production methods of mainstream industry. Due to bricoleur's relation with materials as found, merely untouched, self-sufficient and frugal, it is embraced by designers and artists with a sustainable contemplation (Rossi, 2013).

Designer and artist Ernesto Oroza attributes similar practices in the Cuban context as "Technological Disobedience". Oroza (2013) explains how, during Cuba's isolation from the global trade, while engineers in the country migrated to the US, the population built everyday household goods and even machines for industrial use, only using simple technologies. In this case, a hard crisis has triggered the society to produce highly practical objects with the motivation to answer their daily life problems and needs (transportation, clothing, food and drink) alongside a motivation for survival.

Similarly, De Certeau's view on *making do* implies that one should analyze the operations such as making use of what's at hand, producing temporal solutions, using objects in different forms, in terms of the power relations of daily life. He emphasizes that a more tactical sense of production is achieved through usage, contrary to the actions of abstract thinking, planning, and the actions of the major mode of productions that are strategically functioning since "tactic is the art of the weak". Usage is the answer given to consumption (what power expects from society) and contains various possibilities for objects (De Certeau, 2008, p. 103-114). Use is always unpredictable, De Certeau says, and thus, use can be imaginative, use can be productive. Users do not make strategies, but that does not mean their actions are so far from design. As Campbell underlines the common phrase in Afrikaans "'n boer maak 'n plan" [a farmer makes a plan] referring to such activity.

The exhibition "Disobedient Objects" which took place at the Victoria & Albert Museum in 2014 addressed the role of redefining everyday objects through basic methods and simple modifications through its significant role in social change movements and political activism. Various objects such as pepper gas mask and propaganda bomb which were produced during various social protests in different years around the world took place in the exhibition (Flood and Grindon, 2014). Almost all objects on display attributed to the same ethos of 'making do', the art of the weak, the tactical recompositions and reconfigurations of existing products, disassembled and reassembled in precarious yet unforeseen ways.

IDEO also gathers together dozens of shots of daily actions which they called "thoughtless acts". These acts manifest how people unconsciously behave and come up with their own solution in a world that not always meet their needs. Looking to these practices can be inspiring for designers to create user-friendly products (Suri, 2005). Similarly, designer Jasper Morrison's "The Good Life: Perceptions of the Ordinary" collects together a photo survey of such ingenious solutions and products, rooted in more subjective, intuitive experiences of the designer (Morrison, 2014).

The common aspect of all similar practices and recollections mentioned above is that all works are derived from the available materials and means in a given situation. The means at hand, are both the bits and pieces of objects and readily available products (some forms of resources), and the abilities or skill set of the user-designer-maker (some form of technology - knowing how to make). These means are re-considered and re-defined to respond to the problems, obstacles, needs, or simply the emergence of possibility, of imagining otherwise. In some cases, the solutions can only be achieved by complete decontextualization of the material. While the decontextualized material can solve various types of problems, sometimes a problem can have several solutions through different materials or parts. In short, even though materials and means at hand are not the ideal fit to meet the requirements of a problem, they are often the determinant of the output.

These spontaneous practices of making are a part of everyday life. Ingold and Hallam (2007) take everyday life as a series of improvisational actions and attribute creativity to improvisation rather than pre-planned actions. While many others take innovation as a true form of creativity spawn from the unusual intersections of distinct moments, they suggest life is “always in the making” (p. 3) seamlessly full with improvisational creativity, always productive and relational in its surroundings. Thus, creativity of improvisation is in the process while of innovation is in the end product. By investing creativity to improvisation, they highlight the process of making and producing (Ingold and Hallam, 2007). In *‘*Halletmek’, via examining these objects through design knowledge, we focus on the practices of making and detect the used materials, production techniques to make the improvisational creativity invested in these objects more visible and accessible. As Ingold and Hallam (2007) suggest there is a different kind of creative manifestation in improvisation which we believe designers could be inspired and benefit from.

3 ‘Halletmek’ in Urban Spaces: Usage-Design-Production

The largest part of our study was the field research conducted in Istanbul's public urban spaces for three months. In this process, we observed and documented objects and their details that one hardly pays attention to in daily life. We had conversations with the users and producers of the objects to better understand the underlying causes and processes of production.

In order to conduct the field research, we primarily designated the districts of Istanbul where commerce and social interactions are active and tradesmen and street vendors are widespread. During the first stage, each district was studied for one day; but towards the end of the research, the districts that were determined to have a wide range of examples were visited more frequently. The districts were visited by foot along the main arteries and some smaller streets, through which photographic documentation on the examples of ‘halletmek’ took place. Our previous review on the literature influenced our decision-making process in which objects we would evaluate as ‘halletmek’ and which ones to exclude from our study.

In this scope, we decided that we would include the following types of examples in the examination and documentation during the field research: objects that are placed on the street and reused independently of their defined function; additions such as repairs and modifications applied on existing objects; architectural elements or the applications that were added on to the existing elements of the street (figure 1).

In cases where we had the opportunity to talk with the users or the producers of the examples we encounter, especially in cases where we cannot define what the object is or what kind of a need it answers, short and exploratory interviews were held with the people about their production. We observed that the people we have talked with were utmost eager and enthusiastic about telling the stories of their productions and they were proud of the objects and solutions they have come up with by themselves.

More than 100 examples were documented during the field research process. Among these examples, a sample was created in which similar approaches were categorized, while significantly differentiated objects were still included as exceptions. The selected data and the patterns we have observed during the field research allowed us to determine certain approaches and divergences, and the distribution of the sample through the city was mapped. At this point, especially in the Eminönü, Karaköy, Laleli and Beyazıt regions of Istanbul, we observed that the sample size was largely increasing. The reason for this increase can be attributed to the intensity of trade and tourism practices, the long hours spent by users and tradesmen on the streets and the intense social interactions in these neighborhoods.

Figure 1. Objects from the urban spaces of Istanbul. Photographed by Nur Horsanalı, 2016-2017

4 Analysis Process: Patterns of ‘Halletmek’

When we begin to examine the data collected during the research process, we become aware of several patterns. For example, certain materials, problems, and actions repeat through the city. These patterns we observed allow us to build arguments over certain approaches and divergences.

Examples exist in the street in many different states: the repair of broken objects; the strengthening or modification of existing objects; the assembly of different objects to one another; the re-functioning of found or unused objects; and in the intervention to public space, upcycling found/old objects as well as the interventions to urban features and fixtures. In terms of materials: packaging tape, plastic bottles, wood and plastic vegetable crates are repetitively observed. Especially since the packaging tape is a cheap and highly flexible material, it is widely used on the street for producing and building (making and attaching). The reasons behind the occurrence of these examples are to domesticate the public spaces for comfort or to provide quick solutions to problems encountered in daily life (figure 2 and figure 3). Though in some cases they are used to overcome the municipal rules and prohibitions.

Figure 2. Feeding container for stray cats in Istanbul. Photographed by Nur Horsanalı, 2017

Figure 3. Usage of packaging tape and plastic vegetable crates. Photographed by Nur Horsanalı, 2017

Fish-sandwich (*balık-ekmek* which is a common street food in Istanbul) vendors observed around the Fish Market in Karaköy built their stalls by taping foam boxes on top of each other (figure 4). When asked why all the surrounding vendors use the same tactic and how this method is spreading, one of the sellers who is working illegally told that the municipality officers are periodically taking away their vending stalls and therefore they have to produce a new one every time. He stated that all the informal sellers in the area are seeking for the cheapest and the most practical vendor building methods. When the easiest and most effective method for a particular problem is found, which in this case is taping together the discarded insulated foam boxes found around the Fish Market, information spreads. In the end, all the sellers along the same region are using the same method to build their vendors. This is one example of overcoming municipal prohibitions. But there is something crucial this

experience unpacks: at a certain point, these practices start forming their own know-how. This know-how is then transferred to and employed by other vendors facing the same problems, just as it happens in formal design and production practices.

While some examples are much more recurrent in the city (repaired or strengthen stools, houses built for stray cats in various neighborhoods, stalls of street sellers), some examples emerge as a result of instant inspiration and remain completely unique to their user/producer.

Figure 4. Fish-sandwich vendor in Karaköy. Photographed by Nur Horsanalı, 2017

Materials and problems are also recurring in practice; a material can solve different types of problems or a certain problem can be solved by different types of materials. For example, in a street in Eminönü, we see that plastic fruit crates are stacked and taped on top of each other (figure 5). Although the production method used here is the same as that of the fish-sandwich vendors that we previously encountered in Karaköy, the answered problems are different. The owner has produced this to prevent cars parking in front of his shop; he tells that he had previously placed plastic cones here but cars continued to park regardlessly and even broke the cones. He adds, even if the plastic vegetable crates were broken, he would rebuild it and replace it easily. We observe that the problem of cars parking in front of the shops is a common issue through the context of Istanbul and has been attempted to be solved by various methods and materials through the city: building wooden structures, taping cardboard boxes together or producing a concrete object (figure 6). This taps into the wider discussion of regulations on street and sidewalk use, and the territorial reclaiming of such space by individuals, but that deserves a separate study.

Figure 5. Taped plastic crates in order to prevent cars parking. Photographed by Nur Horsanalı, 2017

Figure 6. Wooden and concrete structures built to prevent cars parking. Photographed by Nur Horsanalı, 2017-2018

These propositions usually emerge from the characteristics of its place and most of the time these objects become invalid when they are displaced. Even small details in these objects contain highly localized solutions. For example, the physical and social features of the bridge specifically inform designs that we encountered on Galata Bridge. Various solutions for keeping the fishing rods fixed on the bridge are derived from the structural features the bridge has. These products are designed as detachable and portable, enabling easy untangling at night, due to the regulations of the bridge.

Another observation from the Galata Bridge is that how a wooden apparatus produced by a local is being reproduced and is now sold on the bridge; and eventually replacing the previous methods and materials used such as fabric, cushion and styrofoam (figure 7 and figure 8). The mentioned object (figure 7), now becomes a commercial product, one that is rooted in the improvisation on the street, evolving towards becoming innovation. Due to its ingenious and cheap nature, it is still widely accessible.

Figure 7. Wooden apparatus used by the fishermen in Istanbul. Photographed by Nur Horsanalı, 2017

Figure 8. Previous methods used for fixing the fishing rod. Photographed by Nur Horsanalı, 2017

In some situations, the objects that are obsolete can only be redefined as new means to an end, when they are completely decontextualized. These examples often arise as a result of instant inspirations. In these processes, the object used is completely alienated to itself and its primary function, only the physical properties and how these features work remain important for the producer. Shifts and breaches between function and meaning are deepening. Using a construction helmet as a water container for cats, placing a rubber boot under a draining water pipe, using an old toilet bowl as a plant pot are examples of this situation (figure 9 and figure 10). Through this, we also observe that the objects in the street and their methods of recycling and upcycling are parallel to practices that are now discussed and used in the field of product design. Such objects also provide examples of the unimaginable degree that users can stretch a product's affordance (Almquist and Lupton, 2010).

Figure 9. Rubber boot alienated from its primary function. Photographed by Nur Horsanalı, 2017

Figure 10. Construction helmets used as water containers for cats. Photographed by Nur Horsanalı, 2017

5 Focusing in on a Selection

67 works were extracted from the field research from our sample set. Through this sample, we examined the possible contribution of daily use and daily production on the design. While carrying out this analysis, we utilized know-how from the design field, such as material and detail analysis and representation through technical drawing. This was far from a visual exercise per se. Following suite by ground-breaking representational work by the likes of Atelier Bow-Wow's "Pet Architecture Guide Book" (2002), re-drawing enabled to us to 'figure out' how these products 'came to be' the way they did. This was by no means possible through photographic documentation alone. Drawing informed us about production stages, how parts and objects came together in a reversal process.

This analysis process gives way to some sort of deconstruction study of the objects first through freehand drawings for understanding the examples further (figure 11). The materials and tools used, parts consisting of the objects, the problems and needs the objects answers were listed together with these drawings. We carried out this analysis just as serious as looking into designed products. Later on, we produced 3D models and isometric drawings of the examples in the digital context, to better explore and represent them.

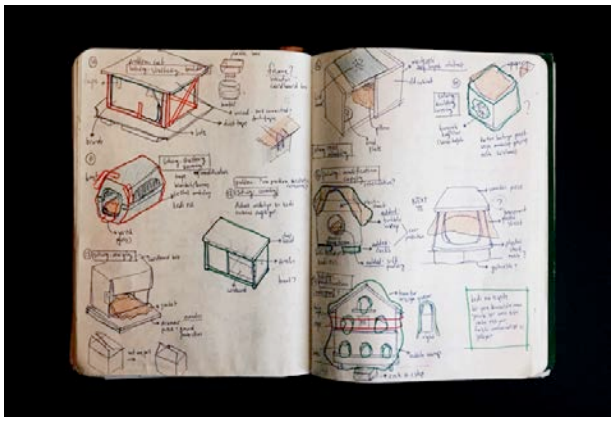

Figure 11. Drawing analyses from the logbook. Illustrated and photographed by Nur Horsanalı, 2017

We have mentioned that packaging tape, plastic bottles, wood, and plastic vegetable crates are repetitive materials on the street. The below list provides all the materials used -including the objects that have been utilized out of their original function- in the sample set we have analyzed:

- Packaging tape, electrical tape, nylon rope, rubber rope, rubber strap, zip tie, metal wire;
- Parcel package, cardboard box, cardboard sheet, foam sheet, corrugated board, shoe box, newspaper, felt, sponge, fabric;
- Plastic bottle, plastic jerrycan, glass bottle, milk carton, yoghurt container, paint bucket;
- Nylon bag, nylon packaging material, bubble wrap;
- Wooden vegetable crate, plastic vegetable crate, styrofoam box;
- Wooden slat, wooden plank, wooden sheet, metal sheet, plastic sheet, marble block, paving stone;
- Nail, screw, hinge, angle bracket, hook, chain, padlock, cement;
- Earbuds, coat, wooden rail shelves, dishwashing sponge, trash bin, plant pot, construction helmet, cushion, dresser, plastic stool, mirror, stroller, rubber boot, toilet bowl, suitcase.

The actions, the problems or needs at stake in the emergence of the objects in our sample set are:

- Repairing, fixing, strengthening;
- Securing, attaching, hanging, organizing, collecting;
- Sitting, exhibiting, protecting, sheltering, carrying;
- Extending, coating, merging, adding, filling;
- Recycling, upcycling, reusing, re-functionalizing, adapting, modifying, building, constructing.

Upon continuation of the analysis, we found that the approaches to deal with the material were differentiated by how raw or processed the material was and how instant or considered the action was. This finding also enabled us to identify the points when these products start triggering knowledge transfer and establishing a know-how. Mapping of the findings on a

diagram was useful for overseeing the entire sample set on a single plane and allowing comparisons towards inferences (figure 12 and figure 13).

Our diagram consists of two axes and all objects are analyzed on these two values. *The material axis* gives information about how raw or processed the end object is; *the method axis* shows how thoughtful or instantaneous decisions are taken during the production process.

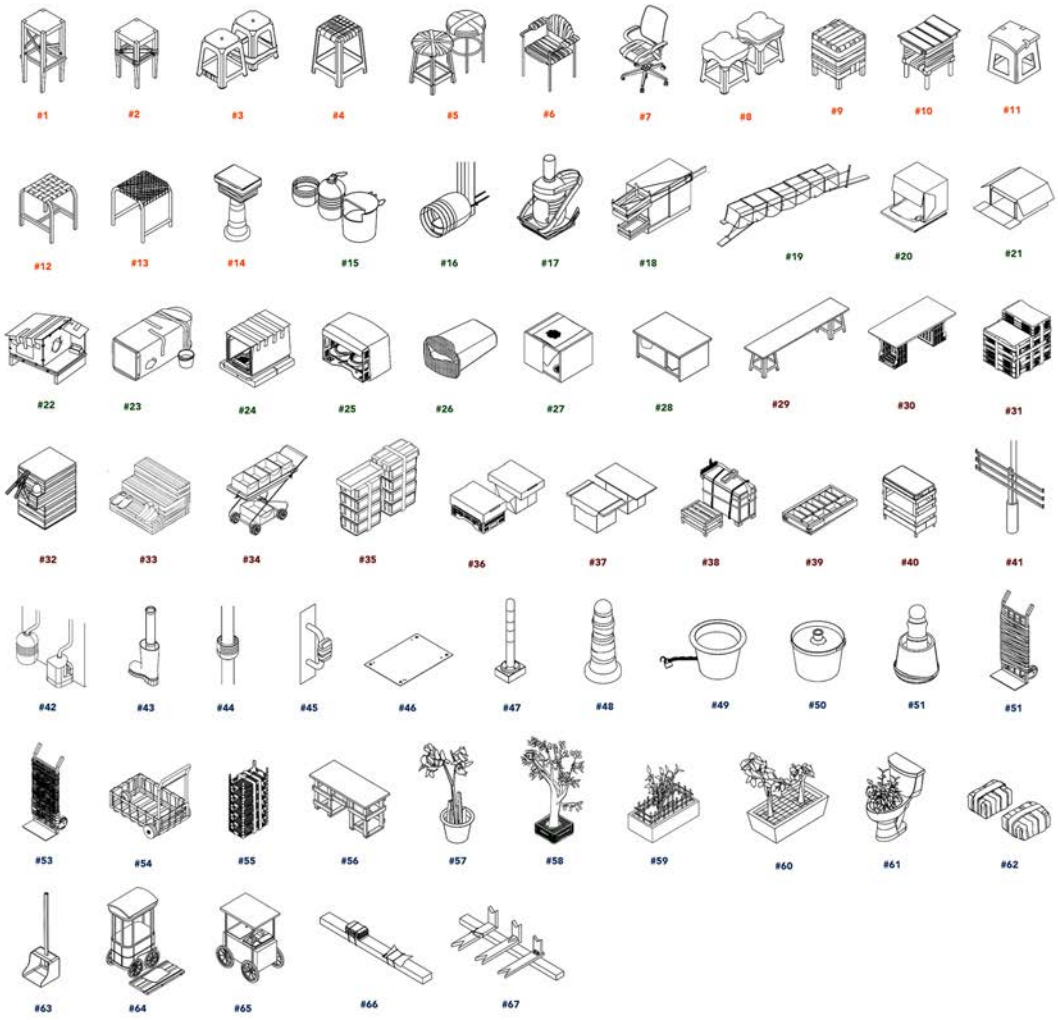

Figure 12. Drawing set of objects. Illustrated by Nur Horsanalı, 2017

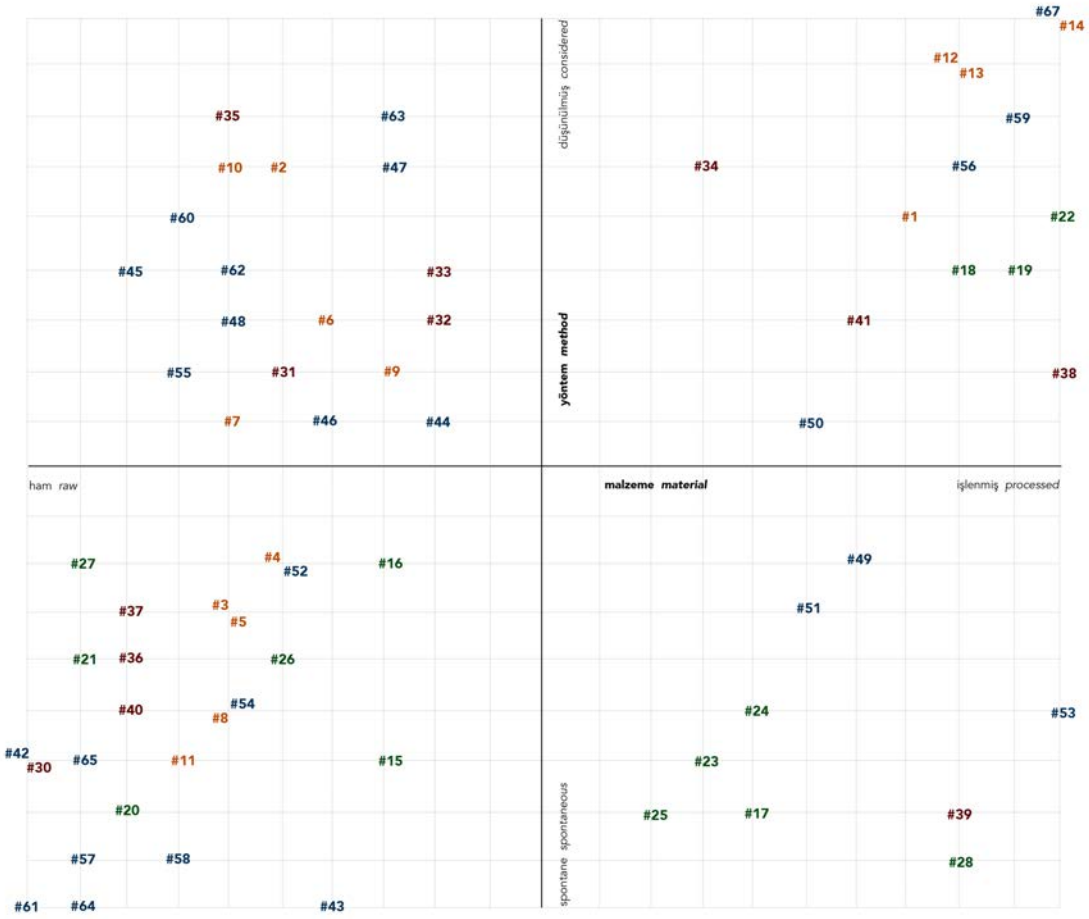

Figure 13. Mapping analysis of the objects on two values. Illustrated by Nur Horsanalı, 2017

After executing the mapping, it was possible to make inferences through analyzing which areas the samples were gathered. For example, objects on the left-hand side of the diagram are commonly seen in various neighborhoods throughout the city. Therefore, we can say that they become part of the urban culture and the urban image. Likewise, since they are frequently repeated in the city, we can suggest that they contain common production techniques and know-how. These objects have also become familiar and normalized by the inhabitants of the city. An example of this is the wooden apparatus used by the fishers at the Galata Bridge (figure 7). We can say that this object has become an important part of Istanbul's urban image. It is likely that most residents of Istanbul know what this object is and what solution it provides when they see it.

The examples on the right-hand side of the diagram are more durable, more permanent, thought-through objects with more complex production processes. An example of this can be the houses of stray cats produced by wood and metal sheets and assembled using hinges and nails (figure 14). The objects that remain in the lower part of the diagram are unique and unusual, usually the results of instant inspirations. Examples, where existing objects are re-functionalized and decontextualized are located in this area. The discarded toilet bowls used as plant pots; or construction helmets used as a water container for cats are in this zone (figure 10).

Figure 14. Cat house built using wood, metal sheets, hinges and nails. Photographed by Nur Horsanalı, 2017

6 ‘Halletmek’: An Inventory

As a result of the research process, we have created an inventory employing the form of a design book, based on the sample of 67 objects that we studied through the aspects of context, material, production, repair and modification techniques using related documentation and drawing sets. Selected objects are analyzed and categorized under four main headings in the inventory based on the actions and functions they have responded: Sitting, Sheltering, Exhibiting, Other Utilities.

Sitting category includes stools and chairs encountered on the street belonging to the tradesmen and the seating units produced by street vendors; Sheltering category consists of houses, water and food containers produced for stray animals in each neighborhood by their inhabitants; Exhibiting category includes stands on the street or in front of the shops produced to display or sell goods; Other Utilities category includes objects or solutions other than mentioned such as transport carts, plant pots, parking barriers.

Each spread of the inventory contains specific information for understanding the context of the object and its production stages (figure 15). The general isometric drawings of the products are accompanied by detailed drawings. The materials used are also visualized by drawings. Each object is given a sample number which makes it possible to locate them on the mapping diagram mentioned, and the position on the mapping is shown on the top left corner of the page. Further information on the inventory page are: a short text describing the location where the object is documented, the function or action it meets, a short description of the production process. The photo that shows the product in site is located on the right side of the page.

This inventory combines text from the research process with anecdotes and inferences, mapping and photographs taken during the field research (figure 16). In addition to being an inventory, the book can provide new perspectives on the possible paths that can be taken by the design discipline.

Figure 15. Inventory page. Designed and photographed by Nur Horsanalı, 2017

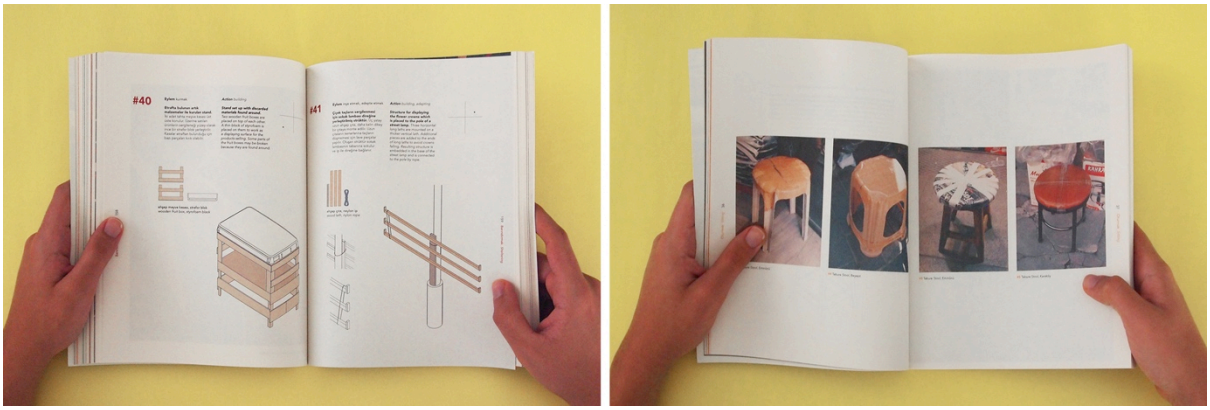

Figure 16. Photographs from the printed book. Designed and photographed by Nur Horsanalı, 2017

7 Conclusion

In this paper, we propose that this instinctively emerging form of design-production that we refer to as ‘halletmek’ should be made visible and be included in design discussions, despite its contrast to the discipline of industrial (product) design in many ways.

‘Halletmek’ offers examples of instant and case-specific problem-solving activity, as opposed to the planned and repetitive design practice, through reconfiguration, adaptation, re-assembly and re-functionalizing of existing objects; or by bringing different pieces together to constitute different functions. These examples prove that innovation and novel ideas can also come out as a result of instant, daily activities and usage, not necessarily as a result of a planned activity.

The way these examples handle use of materials can inspire sustainable solutions. Materials and existing objects are reimagined and reused in different contexts and for different

functions posing as cases of recycle, reuse and repair. Their situation-specific nature can contain aspirations for socially engaged design since the needs and the solutions both arise from lack of social infrastructure, prohibitions and desires. Moreover, while the materials used, the joining details, the combination of the different parts provide their own and situation-specific perspective, they also offer new possibilities for a visual language that demonstrates the production process and distinguishes itself from the planned results of design activity.

These practices, we believe, could inspire designers for alternative approaches to designing and making stuff, repurposing materials and objects, as well as demonstrating the potential of improvisational creativity. However, Campbell (2017) claims professional biases might prevent designers acknowledge the potential in these practices. Considering that the area of product design should more carefully look at the solutions from everyday life, we examined the collected examples just as seriously as looking into designed products by utilizing techniques from the field of design such as technical drawing, materials details, etc. The inventory translates this knowledge from the everyday into information for design field. By this way, the potential in these practices, we believe, become easier to recognize and is made available for product design and any other creative endeavors.

It should be noted that our aim at this point is to advocate the inclusion of examples from everyday life into discussions within the design field, rather than proposing absolute new paths for the discipline of product design. When we consider the examples with such an attitude, we propose that designers can learn from fast and primitive solutions in everyday life; and we argue that it is possible to think about the potential contribution and transfer of ideas along with practical details into design culture.

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Intersection between Architectural Criticism and Building Performance Analysis: current debates and future directions

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Current sustainability challenges demand the built environment solutions that address diverse concerns: energy and resource efficiency, waste reduction, health and wellbeing. Good built environments can mitigate and help to address the global sustainability challenges. However, defining 'good quality' in buildings is no trivial task. The iconic definition of 'well-designed buildings', Vitruvius notion of 'firmitas, utilitas and venustas', suggests that good quality involves the balance between firmness, utility and delight. This balance can be fostered by the intersection between architectural criticism and building performance analysis. This paper discusses the ongoing debates on the integration between architectural criticism and building performance analysis. It is argued that this integration can provide an architectural philosophy where 'good' buildings balance inhabitants' experience and building performance. The paper concludes by identifying future directions and contributions of the design research community to the interdisciplinary dialogue between architectural criticism and building performance, which to date, has remained elusive.

Keywords: building performance, building quality, architecture, professionalism

1 Introduction

The current sustainability challenges related to climate change, energy efficiency, resource management, environmental protection, human health and wellbeing demand high quality solutions by the built environment. Yet, defining 'good quality' in buildings is no trivial task. The iconic definition of 'well-designed buildings', Vitruvius notion of 'firmitas, utilitas and venustas' is certainly a starting point. Good quality in architecture involves a balance between firmness, utility and delight. The balance between 'firmness, utility and delight' can be fostered by the intersection between architectural criticism and building performance analysis. Juxtaposing architectural criticism and building performance analysis can offer architects the opportunity to revalue the profession. The architecture profession is in urgent need to revitalise so the public and clients understand the value that architects embed in their works (Bachman 2013). 'Architects are rapidly losing niche markets as clients engage with other building professionals who are undertaking work that traditionally belonged to architects (Bachman 2013, p.198). Initiatives such as the AHRC 'The Cultural Value of Architecture' and RIBA's efforts to embed research in design aim to promote the skills and expertise that architects bring to building projects around issues of quality. Architects can

deliver value by creating places where people can thrive, combining aspects of place making, cultural and social dimensions and built environment performance. In the special issue of Building Research and Information on 'New Professionalism'[1], there was a broad range of contributions addressing the role of building industry professionals to respond to current challenges, including the role of architects. Duffy and Rabeneck (2013), focus on the pivotal role of architects to respond to the challenges raised by BRI special issue. In similar vein, Bachman (2013) analyses the situation of the architectural profession and argues that due to the increased complexity of the built environment, considerations related to 'evidence-based design, post-occupancy evaluation, commissioning and quality reassurance' are necessary to address sustainability. These literatures highlight the potential role of architects to champion the responses to sustainability challenges. One way forward is developing an architecture philosophy that integrates architectural criticism and building performance analysis as a means to deliver quality. This can promote holistic approaches to building quality that align aesthetic principles, building performance considerations and inhabitants' health and wellbeing.

Architectural criticism analyses the types of experiences that buildings provide. However, it is unlikely to draw from building performance literature. Friedman argues that 'Built environments are material and social events in a continuous state of becoming'; therefore, '... design excellence must now exhibit measurable attributes that account for energy consumption, environmental integrity, carbon management, context and health impact… good looks and good design through the lens of good performance' (Friedman 2015, pp 267). Academic debates are being articulated under the concept of 'performativity in architecture' to integrate architectural criticism and building performance considerations; notable references include (Kolarevic and Malkawi 2005), (Hensel 2013), (Kanaani 2016).

This debate is gaining traction in the architecture profession. There is indication that architects are increasingly considering how buildings are designed to offer their inhabitants better experiences and delivering better quality as a result. There is empirical evidence that architects are deploying a number of strategies in this realm i.e. (1) exploring the expectations and needs of occupants and other stakeholders to inform the building design and the as-designed performance estimations, (2) articulating the building design intentions and applying tactics to facilitate the achievement of as-designed building performance intentions (Zapata-Lancaster, 2019). It is encouraging to see that architects are undertaking different types of 'investigations' which could increase quality, foster learning from existing buildings and inform the design process ie. the application of POE results (Hay et al 2018). After all, it is widely recognised that reflecting and learning from building performance: (1) increases stakeholders' knowledge, particularly designers' knowledge about quality and value of design (Whyte and Gann 2001); (2) informs solutions to increase usability and adaptive opportunities in existing buildings (Bordass et alt 2001); (3) informs design strategies in buildings (Carmona-Andreu and Oreszczyn 2004); to name few benefits. Concerns related building quality have been voiced by architecture schools who identify the need to juxtapose design quality and performance analysis (Stevenson 2019). Given these ongoing debates and the urgent need for architects to play a proactive role in addressing global sustainability challenges in their built environment responses, the next section of the paper outlines how architectural criticism and how building performance analysis define

[1] Building Research and Information 2013 Volume 41, Issue 1: New Professionalism

building quality. The paper shows areas of intersection between these disciplines and identifies how the design research community could contribute to the ongoing dialogue and the interdisciplinary integration between architectural criticism and building performance considerations; which to date; has remained elusive.

2 Defining building quality

2.1 Architectural criticism's view of building quality

Bruno Taut, a prominent architect and architecture critic, argues 'the aim of architecture is the creation of the performance and therefore most beautiful efficiency (Taut 1929). Kolarevic (2005) claims that 'performance-based design should not be seen as simply a way of devising a set of practical solutions to set of largely practical problems … design is grounded at one end in intangibilities such as cultural performance and, at the other, in quantifiable performative aspects of building design, such as structure, acoustics and environmental design'. The notion of performance has also been linked to active human agency (Hensel 2013, p.17) and the [balanced?] relationship between people-environment; not only as an objective matter but also as a subjectively perceived reality (Hensel 2013).

The notion of good building quality is also intrinsically related to the notion of experience and delight. In his work on environmental design, Hawkes (2007) argues that '[enjoying] buildings implies a wholly different dimension to the idea of the architectural environment from the pragmatic and mechanical process of climate modification and comfort engineering in quantitative terms such as degrees, noise levels, illuminance'.

Another complimentary notion of quality in architecture is related to the concept of 'performativity. Kanaani (2016) argues that 'Performance-based design theory asserts building performance as a guiding principles and approaches towards the creation of intelligent and novel architecture form-making'. She refers to the paradigm of performativity within the context of architecture principles and building performance propositions. She illustrates this way of thinking by referring to examples from vernacular architecture. She then discusses modern architecture examples and how the application of light (and lighting considerations) has created an intended quality where performativity, where the values of architectural criticism and building performance meet. She emphasises that 'Performance-based design inherently embeds ambitious globalized objectives' (Kanaani 2016), suggesting the benefit of an explicit integration between the fields of architectural criticism and building performance.

It should be noted, that the trajectory of architectural criticism has criticised the emphasis to form without consideration to function, experience or other aspects buildings are expected to deliver (Pallasma 2016). It has pointed out at the creative opportunities afforded by performance considerations to create meaningful experiences for inhabitants of buildings. This is a key proposition where building performance discipline intersects architectural criticism.

2.2 Building Performance field's view of building quality

In order to define building quality as per building performance thinking, we first need to define what performance is. The concept of performance unpins the concept of quality of buildings. Performance approaches in building design imply that explicit requirements are articulated in terms of goals (outcomes) that specify how the building should function

(Gibson 1982, Lutzkendorf and Speer 2005). In the performance-based approach, level of performance is defined in terms of outcomes and expected goals so as to allow different strategies and combinations of building parts/components to be assembled and integrated together in innovative ways that deliver best value for money (Sexton and Barrett 2005).

A seminal contribution that consolidates the diverse and rapidly growing field of building performance analysis is the work by De Wilde (2018, 2019) who defines what building performance is and highlights the complexities and challenges of the field in relation to built environment professions. In his analysis of the implementation of building performance thinking in design, he argues that the performance analysis 'remains elusive in design'(ref) due to the difficulties to identify constraints, design enquiries and knowledge during design process. While his main thrust is the application of normative decision-making approaches; he recognises that design problem solving may operate under 'naturalistic' problem-solving patterns.

An interesting point should be made in relation to the historical evolution of building performance analysis, particularly in the context of energy efficiency in existing buildings. The energy efficiency agenda started as a response to oil crises. Solutions were initially informed by engineering perspectives and deployed technical solutions to overcome challenges. In the last couple of decades this area has rapidly evolved to consider the 'human' element of buildings and the impact of the occupants on building performance, including their impact on performance gaps. Building occupants are increasingly recognised as knowledgeable agents who are eager to take action in buildings. The building occupants, or inhabitants, are no longer perceived as passive recipients of buildings. They are seen as actively engaged agents who interact with buildings and their technologies. As a result, buildings are seen as complex systems that need support the needs and expectations of inhabitants (Cole et al 2008, 2010, Tweed and Zapata-Lancaster 2018).

There are interesting insights to learn from the pathway that building performance evaluation[2] field has adopted in relation to the energy agenda in existing buildings. Current developments are embracing socio-technical approaches and user-centred perspectives to nudge behaviours. Interventions are combining technical solutions and behavioural aspects to achieve reductions in energy use in buildings.

An interesting observation about the developments in architectural criticism and building performance analysis is that both fields have raised concerns about the undermined quality of buildings. It is argued that the industrial context had favoured 'simplistic, deterministic and linear assumption of industrial-age production' (Bachman 2013 p 754). Current challenges demand solutions that are 'organic, open cycle, complex and systemic' (Bachman 2013).

[2] Building Performance Evaluation is the process of assessing if a building satisfies the needs and purposes of its inhabitants and wider stakeholders, it can be conducted at any stage of the building life cycle. It is related to Post Occupancy Evaluation when focused on operational stage and occupants' perspective. Building Performance Evaluation is one of the 'branches' of application of building performance analysis in existing buildings.

3 Way forward

Architectural criticism and building performance analysis can complement each other and enrich the solutions to current sustainability challenges faced in the built environment. On one side, building performance analysis can augment the scope of the architectural criticism analysis. On the other side, building performance analysis can learn from arch criticism in that criticism 'reflects prevailing cultural and philosophical attitudes of its time' (Davis 2015, p23)

These 2 disciplines have traditionally deployed different lenses, methods and philosophical positions to assess building quality. Yet, ultimately, their agendas and goals are fundamentally complementary. In the developments and debates of these fields, there is an overarching concern about quality. Architectural criticism is moving beyond the narrow view that mainly focuses on aesthetics (buildings as sculptures/works of art as ultimate goal) and building performance analysis is moving beyond a utilitarian view of buildings (buildings are no longer seen as mere physical assets or 'machines for living'). Both disciplines are considering the socio-cultural dimension that enriches the concept of quality. Such renewed focus has the potential to revitalise and bring together the dialogue between architectural criticism and building performance analysis. This future integration can be facilitated by the design research community.

Key themes where these disciplines could converge, facilitated by design research thinking are: (1) consideration of multilevel perspectives i.e. integration of social and cultural factors; balance between the perspective of different stakeholders: i.e. occupants, developers, policy makers; connecting different stages of the building life cycle; applying designerly ways of knowing and problem-solving models; considering the synergies between variety of scales (from buildings to cities). The integration offers the opportunity to develop a philosophy where accountability, responsibility and leadership goes back to architects.

Current developments are rapidly changing the landscape of the building industry work, ie. the digital applications and new modes of collaboration. Design research thinking can offer new forms of evidence-based responses to recurrent and contemporary challenges related to climate change, sustainability and global challenges (energy efficiency, health and wellbeing, waste reduction, circular economy, resilience, global warming). Integrated solutions that combine considerations of inhabitant's experience and building performance analysis can help building industry professional, particularly architects, to devise new solutions and approaches improve building quality by delivering increased building performance and higher satisfaction of occupants in buildings.

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Openness, graphic design and visual practices of science: exploration to promote innovation

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This article presents an ongoing research on the visual practices of experimental scientists. We look at the way scientific visuals are constructed, to understand how the processes promote exploration and expansion, which are central proprieties supporting innovation in the context of scientific research. Based on a series of in-situ and semi-directed interviews with experimental sciences imagery stakeholders, this inquiry aims at identifying proprieties of the "beautiful image of science", using the notion of "beauty" as a basis to better understand the underlying criteria leading to decision-making in the processes of scientific imagery. This research shows that moments of openness and practices of design are present at certain stages of the imagery workflow, and could be emphasized to encourage exploration for discoveries.

Keywords: openness; scientific imagery; graphic design; innovation

1 Some definitions

In this article, the word "science" will be used to refer to experimental sciences, as practiced in laboratories of natural sciences: mostly biology and physics.

Design(ing) practice (Hatchuel & Weil, 2003) is used in place of the French word "conception", defined as: action of elaborating something new in the mind, and to build it (be it material or not), (CNRTL, 2019; Larousse, 2019). We will use the words "conceptive" and "designing" as its adjectives. To refer about professional designers' practices, we will use "practices of design".

Lastly, the expression act of design, here mean: the processes, tools, and thoughts used to conceive (as a design practice) solutions to complex problems (Findeli & Bousbaci 2005; Manzini, 2016).

2 Introduction

This article is based on a review of literature on the visual practices of experimental sciences, and on design research as it looks at design effects on "ways of thinking and doing" (Manzini, 2016).

2.1 Visual representations and the work of science

Visual artefacts involved in knowledge construction (Coopmans, Vertesi, Lynch, & Woolgar 2014; Lynch & Woolgar 1990) have been studied by many disciplines since the 80's (Allamel-Raffin, 2010; Anderson, 2009; Bigg, 2012; Burri & Dumit, 2008; Cambrosio, Jacobi, & Keating, 1993; Lynch & Woolgar, 1990). It reflects an interest in the making of science as it is correlated to the mobilization of images.

Studying pictures of science offers interesting perspectives to understand paradigms of knowledge acquisition (Daston & Gallison 2012; Latour 1985). Documenting the way scientists compose visuals, in relation to their context, helps identify relationships between working context, social organization, disciplinary points of view and the way visuals – either analogical or digital – are appreciated (Amann, Knorr-Cetina, 1990; Dondero, 2009; Vertesi, 2014). These studies establish that perception, study, and understanding of a research object are redefined by its forms of representation. Taking visuals into account also leads to a better understanding of scientific rhetoric (Allamel-Raffin 2006; Fontanille, 2009; Latour & Woolgar, 1979; Merz 2009), and, more globally, capture the values, status and uses of scientific imagery (Dondero & Fontanille 2014).

Apart from this rich literature mostly from Science and Technology Sudies (STS) and Visual Studies of Science (VSS), there is little research reflecting on the crafting of these artefacts *per se*: looking at their construction and questioning the processes and criteria leading to decisions in the making of images. The conditions of their production are accessible, as they have to meet the standards of scientific transparency (Dondero, 2010) but studies rarely take the visual practice as a starting **and** ending point. Some studies in VSS focuses on the relationships between works of art or design, and scientific imagery (Renon, 2016) but rarely *in situ*, despite taking into account how images are made (Allamel-Raffin, 2013; Dondero & Fontanille, 2014). Some recent works from HCI offer task-analysis of experimental work of science, reflecting on the way scientific visual processes could be improved to enhance research findings (Solano-Roman, 2018). Finally, it seems there is very little about the designing dimension that lies within experimental sciences "at work".

If scientific images play an important role in the construction and perception of scientific objects (Coopmans, 2014; Vertesi, 2014), a lot is at stake for design in questioning the conceptive dimension of scientific image-making.

2.2 Openness and innovation

Our question is therefore at the crossroad of STS, VSS, design, and epistemology. We suggest that to better understand the conceptive parts of science, we need to elaborate on design research to better understand them.

Contemporary literature about design suggests that design reshapes *ways of thinking and doing* (Cross, 1982; Findeli, 2001 ; Gultekin-Atasoy, Lu, & Bekker, 2015; Manzini 2016) and can transform the known world into a preferred one (Findeli, 2012). A key concept of this research on design is openness. Openness is related to the notion of exploration, and can be defined as "the number of particular thoughts an expression may elicit in an individual" (Lagerwerf & Meijers, 2008). It expands perceptual inferences, and is thus seen as a privileged way to formulate innovative propositions, innovation relating to the capacity of expansion (Hatchuel & Weil, 2003) as well as **inventing *novel ways of doing***. The notion is already found in some scientific activities, for instance when scientific students "(…) are given the initiative of finding solutions to problems" (Simon, Jones, Fairbrother, Watson, &

Black, 1992 quoted by Haigh, 1993). More importantly, scientific research can be considered as “a matter of discovering and **inventing novel ways of seeing,** identifying (…)” (Lynch, 2014).

Openness also qualifies practices of design (Self, Evans, & Dalke, 2013), supporting for instance exploration of an object (Gaver, Dunne, & Pacenti, 1999). Based on the literature from management of innovation (Le Masson, Hatchuel, & Weil, 2011), we think that it is a propriety of the *act of design* to organize conditions of openness to enhance exploration, expansion and invention of preferred solutions (Gentes, 2017).

Elaborating on this literature, we want to look at visual practices of scientists, and explore if **there are forms of openness that support exploration and heuristic in the apparently positivist field of experimental sciences.**

3 Fieldwork: interviews with scientific imagery stakeholders

To understand how openness can be organized in the context of scientists’ visual practice, we interviewed scientific imagery stakeholders (SIS). We chose these people after an ethnographic observation made at Pasteur Institute in a microbiology laboratory from March to April 2017.

3.1 Methodology

We will first explain why we used the notion of beauty to question criteria involved in the making of scientific images, then we will present our approach to focus on design-specific issues. Finally, we will present the interviews.

3.1.1 Beauty, taking care and criteria

The notion of beauty in itself appeared as an important criterion from a first series of informal interviews conducted at the beginning of our research, in October 2017. We wanted to identify themes and values that SIS thought important for science at work. The interviewees regularly told one of the authors that, “because she was a graphic designer”, they had “a nice image” to show her. Based on the anecdote theory (Michael, 2012), our intuition was there was a bigger picture behind this term “nice”, and the circumstances of its enunciation, than just a tribute to graphic design.

In addition, the two months of immersion at Pasteur raised an unexpected number of issues regarding creation, care and beauty in the work of scientists. Reflecting on it, associated with the beauty concept, were the scientists taking so much care of their images for scientific reason only?

Our hypothesis is that “beauty” as a situated notion can be used to retrace the cares that the scientists put into the making of their images, so as to understand how rules of composition, commonly-shared imagery knowledge, and aesthetics criteria guide their visual practice. That is to say, this **notion could be used to discuss visual practices of scientists, in particular to find new insight on the designing and innovative dimension of their visual work.**

3.1.2 Starting from the visuals to perform retro-designing

As part of this enquiry, we collected images given by the actors to perform *retro*-designing as taught in design schools*:* we analyzed visuals in relation to their pragmatic, semantic, social, and political dimensions. We made the hypotheses that confronting actors and their choice

of images with this design approach could lead to interesting insights in terms of visual practice.

3.1.3 Conducting interviews with scientific imagery stakeholders

We conducted interviews with nine actors from August 2018 to January 2019 so as to discover criteria that impact the way scientific visuals are constructed and to see if the scientific imagery processes are “open” enough to support the scientific exploration and reformulation of problems.

These interviews were semi-directed, in a pragmatic constructivist inductive approach. They lasted between 58 and 73 minutes. One took place in a public place, one on skype from the scientist’s laboratory, and the others in-situ, at the workplace of the actors, in the laboratory room, at their desk, or in meeting rooms.

Our nine actors were:

- Three confirmed researchers, from quantum physics (KC), neurobiology (TG), microbiology (JU).
- Three post-doc or doctoral researchers, from astrophysics (BD), microbiology specialized in microscopy imaging for embryogenesis (QW), and neurobiology (NU).
- One researcher in mathematics and computer science, specialized in signal and image processing (JC).
- Two engineers specialized in the treatment and analysis of biologic images (NZ and QT), working with biology researchers, and medical researchers.

A few days before the interviews, we asked the actors to give us a “beautiful scientific image”. During the interview, we first asked the interviewees to present themselves, then asked: “Why is this image a « beautiful scientific image? »”. This opened the discussion, focusing on the personal appreciation of the scientists as well as on their use of images in their work. We asked about:

- The context of use, and manipulation of images at work.
- The constraints related to the making of images
- The degree of openness in the process of images-making: when the scientist’s decisions are open to discussion.

Afterward, we conducted a thematic analysis.

3.2 Preliminary Results

Out of the nine requests to obtain a “beautiful scientific image” before the interview:

- 5 actors presented images made by themselves, or by collaborators in the context of their work.
- 4 actors presented images selected from other research, from their field.
- 2 actors proposed two images instead of one.
- 3 actors presented composite images (made of several images) (fig.1, a, c.).

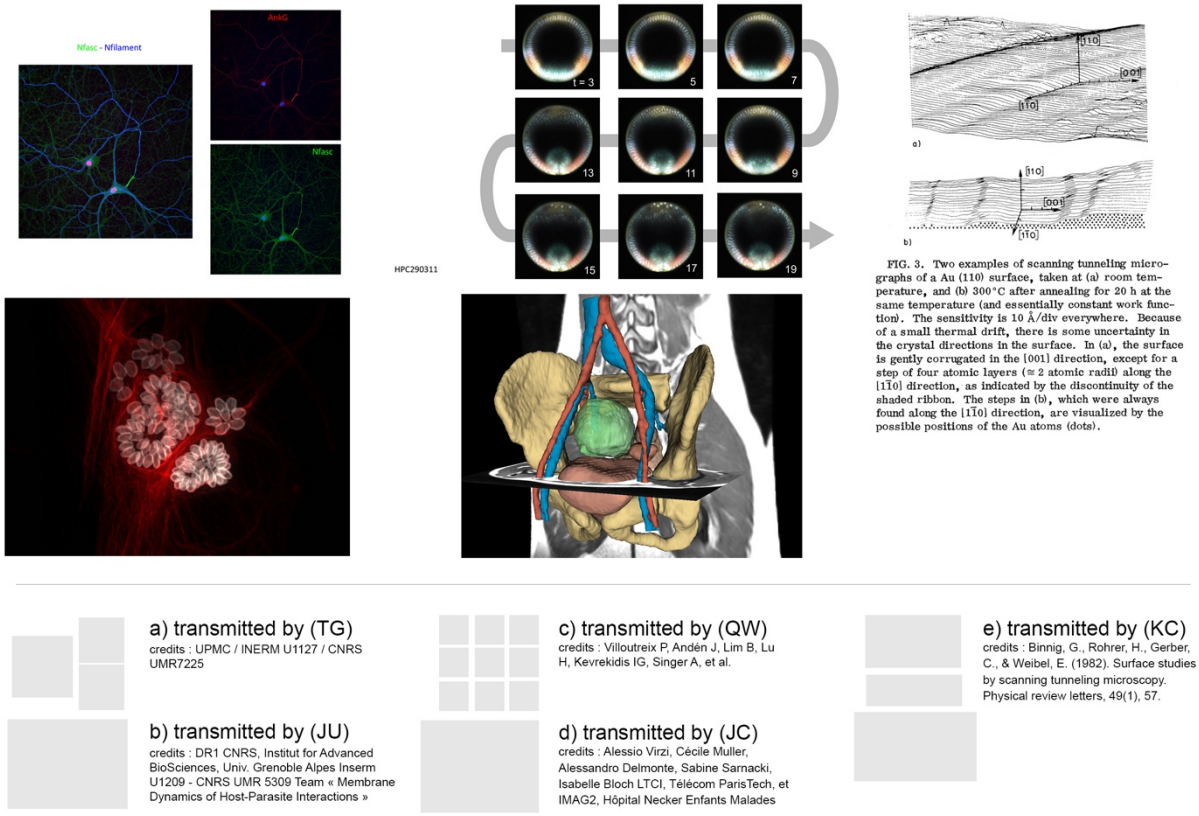

Figure 1. A selection of « beautiful images of science" given by five of our actors. a) neurons culture, imaged to identify « pre-nodes ». b) Colored movie frames obtained with data fusion algorithm of molecular signals and morphology during the DV patterning of Drosophila embryo. Retrieved from https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1005742 c) toxoplasmosis imaged by fluorescent microscopy (white structures) that "looks like flowers". d) dynamic 3D visualization of a human pelvis, that can be rotated in three axis. e) an "image of great importance" in the "scientific community" of (KC): "that was the first time we « saw atoms. »". Atoms are the dark dots, and dark lines shows levels of electronic measures that attest "presence of atoms". Retrieved from Binnig, G., Rohrer, H., Gerber, C., & Weibel, E. (1982). Surface studies by scanning tunneling microscopy. Physical review letters, 49(1), 57.

3.2.1 Qualities of images

Arguments about the notion of beauty associated with the visuals allowed us to identify several qualities:

- Emotional response: the beautiful image "appeals to the eye", "catches the attention"
- Immediacy: results rapidly conveyed. Actors differentiated "more visual image": "This one is a talkative image because we **directly** see the embryo's morphology, and we **directly** see what it depicts of the process as genetic expression, through the colors put on the image", from images "like mathematical graph".
- Clarity: immediacy was linked to the clarity of the picture. The clarity depiction of the visual representation might be linked to the ontology of the scientific image itself: "Normally, it is on a tissue, not translucid, so they made it translucid so we can see it".
- Mnemonic function: "When we want to transmit something, be it in a scientific article or a seminar, pictures are what people memorize the most".

3.2.2 Scientific facts and the symbolic value of image

The most emphasized criterion was that the image should present scientific information and represent significant findings. They qualified beauty not only through the aesthetic qualities of images as described in 3.2.1., they also qualified beauty as lying in the scientific fact itself more than the “immediate visual aspect”: “a relation between two things that depict a physical phenomenon, there is a certain form of beauty, but less immediate”. Unveiling a scientific fact either contemporary or in the history of science is crucial to the definition of a beautiful scientific image according to the interviewees.

3.2.3 Importance of academic and scientific normativity versus composing, compositing, and decision-making

All actors noted the importance of the normative scientific context in relation to characteristics of their images: “we know that the core is blue, cytoskeleton is often green… there are standard colors. (…) people usually use the same colors codes”. Normativity was also linked to technical constraints, as with the fluorescent marker applied to perform fluorescent microscopy (NZ, JU, NU, TG).

However, it appeared that scientists have a composing and compositing practice that takes place at different steps of their work. They built their own technical protocols to match physical and biological constraints, and obtain the image they are looking for. This includes operations of exploration, reduction, selection, appreciation. While they do not play on contrasts, they still make choices about cropping, coloring, developing elements of the picture. What is more, the decisions made to select and define the protocols are discussed within the laboratory, to obtain a preferred solution chosen based on the pragmatic conditions, such as the technical apparel at disposition, the time allowed for the research, or the object manipulated.

Finally, they compose their images in relation with the different steps of the research work: experiments, analysis, discussion, publication. Not only was it suggested that images qualified as beautiful had more chances to be broadly diffused, they also are different versions of the same scientific knowledge.

3.2.4 Fruit of a Collaborative work and communicative artefacts and skills

Image-making appeared as a collaborative work, involving specific expertise from each scientist, but also from specific technical fields such as lab technicians specialized in scientific imagery, or engineers specialized in mathematics applied to informatics. One of our actors emphasized the value of pursuing collaborative work with researchers from different fields of experimental sciences, as in physics. In this context, images work as a common goal and support for discussion, that is enriched by the diversity of expertise and perspectives.

- To make an image, researchers consult specialized technicians
- To analyze and treat images, scientists consult specialized informatics engineers
- To discuss qualities of the image and eventual findings, scientists use digital and analog drawing tools to detail their impressions, intuitions and hypotheses.

4 Discussion: are there designerly ways of doing science?

Primary results of this inquiry suggest that, in their visual practices, scientists perform *acts of design* that are not acknowledged as such. Even if the positivist norms indispensable to perform scientific research produce effects of fixation (Hatchuel, Le Masson, & Weil, 2011),

as seen for colors choices, an important conceptive dimension seems to take place in the context of their visual practice.

Indeed, scientists compose their visual daily routine on the basis of a wicked problem-solving approach, looking for plural solutions to one problem. They take care of their situated images, **adapting or inventing** processes until its satisfying considering their question of research. To do so, they **question** their imagery processes, **reformulate** their approach, and discuss it to better understand what it brings to their research, in order to construct an accurate preferred solution. They take care of their images to maximize their perceptual inference, organizing condition of openness to **enhance exploration** and **disclosure** of scientific information, but also in order to make their message clearly address the scientific community. These designing visual practices seems to **promote expansion**, as, reshaping their questions of research, they expand the findings of their field and its technical landscape.

To summarize, conceptive visual practice of scientists appears *designerly* in the way it seems to support conditions of openness and to promote innovation by means of specific operation which contribute to exploration, disclosure and expansion, as redefinition, rethinking, reformulation (Gaver et al., 1999; Hatchuel, 2001; Newton, 2004; Gentes, 2017).

5 Conclusion: Adopting a design approach to question ways of seeing and knowing

To study what stands at the crossroad of science, design, and epistemology, we developed a method that is based on interviews on what actors considered as beautiful images. This allowed us to discover forms of openness involved in the making of scientific images and in the semiotic qualities of the artefacts.

These results take place in an *Emerging design* paradigm (Manzini, 2016), which opens up perspectives on practices of design performed by people that are not labelled as designers. Manzini call it *diffuse design*, that is “the natural human ability to adopt a design approach, which results from the combination of critical sense, creativity, and practical sense”. This approach helps us question the methodology and tools utilized to produce and use visuals, and how to support the conceptive approach within experimental sciences.

Placing these objects under the scope of *designerly ways of knowing,* we may question “what they **could** be”, encouraging innovative propositions that promote further explorations. Acknowledging similarities of scientist’s visual practices with the ones identified for design should support *new ways of doing and thinking* in the context of scientific research.

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Para-design: Engaging the Anomalous, a design research workshop to investigate paranormal phenomena through a series of location based studies

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An investigative workshop entitled 'para-design' (paranormal design - thinking beyond or outside of 'normal' design scenarios) explores new territory for design practices. Through examining the degree to which parapsychological belief influences perception of the designed environment, research brought together the anomalous with product design in order to explore design applications. In this context, the term paranormal refers to the conceptualization of paranormality as a phenomenon that violates the fundamental scientifically founded principles of nature.

Specifically, Product Design students investigated paranormal perception. Students explored locations and appraised environmental conditions/unusual experiences. A self-report measure included feelings, experience and perception questions. Following investigation, respondents completed questions assessing belief and perception in each location. Typically, locations contained many classic paranormal settings i.e., cold spots, dark/claustrophobic, damp, drafts/chills etc.

Specific high perceptual scores were associated with an increased level of perceived haunting and an increase in paranormal belief. Findings suggest that practice based studies through 'para-design' shapes intention, where paranormal belief influences perception of the designed environment. Field-testing generated design proposals to produce paranormal products. These became the centrepiece of an exhibition where interaction with each product revealed how to investigate the anomalous. Specifically, the combination of para-psychology and concept of para-design revealed how design can elicit, engineer and channel perceptive experiences of the paranormal.

This research outlines the significance of para-design. Through the translation of subjective and analytical responses, new opportunities for design were investigated that explore personal perceptions to enable the design of tools that facilitate and respond to paranormal phenomena.

Keywords: Product design, para-design, paranormal belief, practice based studies, perception, investigation

1 Introduction

Students studying Product Design at ArtEZ Institute of the Arts in Arnhem, in the Netherlands, took part in a design research project to investigate the design of spaces and

paranormal experiences at two Dutch locations. Research consisted of a series of location-based investigations to garner perceptions of the anomalous. Specifically, through self-report measures, students explored locations, noting down any unusual sensations/phenomena on a map provided, followed by answering a series of questions examining feelings, experiences and perceptions. Respondents noted down unusual experiences alongside their appraisal of the environmental nature of each location i.e., characteristics, feel, temperature etc. The notion was that students would engage with paranormal phenomena in order to develop a brief within their design practice.

The paranormal in this context refers to “a proposition that has not been empirically attested to the satisfaction of the scientific establishment but is generated within the non-scientific community and extensively endorsed by people who might normally be expected by their society to be capable of rational thought and reality testing.” (Irwin, 2009).

The paranormal material gathered from both the Panopticon prison and from the spiritual centre at Harmonia, place the perceived experience and design brief within specific practice based studies, exploring the concept of ‘para-design’ (paranormal design - thinking beyond or outside of ‘normal’ design scenarios). This allows examination of the degree to which paranormal belief effects perception of locations, and then how to generate design scenarios for new environments.

Students employed field research (fieldwork) using a spontaneous case approach (Parsons, 2018), which allowed them to directly observe and explore two locations (Harmonia & Panopticon). This method is concerned with data collection and verification, whilst generating ethnographic and observational data (Burgess, 2002). This in turn, created discussions on how design can be used as a tool to elicit, engineer and channel perceptive experiences of the paranormal. Specifically, field research provided students a way of studying each location within its "natural" setting. Therefore, students collected data using observational techniques and evaluated findings which generated theoretically rich data (Baxter & Chua, 1998; Johnson 1990).

Experiences helped define and translate subjective and analytical responses into the development of new opportunities for product design to identify factors that contribute to the perception of the anomalous. The designed experiences created through the workshop allowed investigation into how design facilitated the exploration of personal belief, and in so doing, generated design scenarios that related to the environment and language of tools that influence behaviours in response to paranormal perception. Design-led approaches are useful and widely used in experimentation, and represent a method to test existing theories and new hypotheses (Bucolo & Wrigley, 2012).

Specifically, design in the form of para-design explored the ontologically flooded territory of interpretations of experiential paranormal phenomena in order to innovate design territories. This provided a workable framework to consider opportunity for design to engage with personal accounts of experiences and belief (Fort, 2008). In this context, haunting/ghostly experiences may derive from internally perceived phenomena (e.g., sensations of a presence) (Laythe & Owen, 2012). However, the current research focuses on the value added by para-design in terms of exploring the rationale for possible interpretations of paranormal phenomena and how this leads to a new design language.

Current academic design practices often insist on a reductionist approach, reducing more complex understanding into simpler components (Sawyer, 2002). This over-simplification of human behaviour and cognitive processes may make experiences more accessible, although a reduction in one's experience to the purely physiological often explains away unusual experiences as merely delusional (Hunter, 2018). The current research utilises a more open-minded (non-reductionist) approach allowing a more experimental analysis of the experience, generating innovative practice between areas of design and parapsychology. This mindset to explore notions of design beyond normal physical parameters expands the scope for design to embrace 'new frontiers' of design language. It's through this experimental mindset that the para-design workshop facilitated discussion between psychologists, designers and people that shared an interest in paranormal phenomena developed through site visits and field research. This discussion produced interesting perspectives on possible applications for the design of experience.

2 Engaging the Anomalous through design research

On the first day of the workshop students investigated notions of the paranormal through discussion and debate with the research team. looking at the psychology of the paranormal and how this translates through the design of experiences students then used the afternoon to rapidly model ideas for experiential scenarios in paper and card, as shown in figure 1. These prototype situations and devises were used to illustrate potential ways to filter the perception of paranormal experience.

Figure 1. For viewing ghosts caught in peripheral vision (left) Light and shadow installation prototype (right).

For the second day we went on a day trip and spent the morning at Stichting Het Johan Borgman Fonds in Odijk to view the 20th-Century Dutch academic parapsychology, spiritualism and mediumistic art collections. Psychologist Dr Wim Kramer and Lotje Vermeulen talked with the students about the archives and current research, explaining how the archives had accumulated over the years and also demonstrated artefacts used to make contact with the spirit world. These 'spiritual products' gave valuable insight into the design of objects to facilitate paranormal perceptive experiences.

Through analyzing the design of the objects and packaging used to popularize the idea of engagement with the paranormal through games/ artefacts such as Ouija boards, and trumpets to capture the whispers of spirits in seances, as shown in figure 2, students had the opportunity to situate design thinking in an experimental context and through empathic engagement learn new ways of relating the design of objects to facilitate a particular tailored experience that goes beyond conventional design practices.

Figure 2. Ouija board (left) and Aluminium Trumpet (right)

After exploring the archives in Odijk we visited the Harmonia Spiritualist Headquarters in Utrecht, where we conducted a building study to test the environment from which the objects held in the archive would have been used to filter anomalous phenomena, as shown in figure 3.

Figure 3. Harmonia Utrecht (left) and Room setting at Harmonia (right)

The design of the study was to use a questionnaire to structure the collection of data examining paranormal belief and individual difference. Specifically, this investigates how paranormal beliefs affect general perceptions of space. This study explores how analytical (rational) and experiential (emotional) factors affect perceptions of the physical and the paranormal (Epstein et al., 1996).

Students completed a questionnaire booklet containing psychological and parapsychological questions, cognitive and perceptual items as well mapping experiences on a plan over the eight locations. Small groups of students (2-3 in each) explored locations documenting unusual phenomena, feelings, sensed presence etc. Measures included the Australian Sheep Goat Scale (ASGS) (Thalbourne & Delin, 1993), The Haunting sub-scale (8-items) (Drinkwater et al., 2017) and the Survey of Anomalous Experiences (SAE) (Irwin, Dagnall & Drinkwater, 2013). This allowed collation of psychometric data that would be useful in quantifying personal beliefs alongside experiential perceptions within specific locations.

The research generated paranormal narratives of specific experiences (Harmonia, Utrecht and the Panopticon, Arnhem), in line with Eaton, (2018) who developed place based meanings from specific interpretation of percipients cultural knowledge, and Wiseman et al. (2002) who explored haunting at Hampton Court Palace. In this context, place based meanings or personal experiences from within unusual or unfamiliar places generated interpretations of phenomena triggered by sensory cues (Eaton, 2018). The current study examined pre-existing cultural representations/perceptions that influence interpretation of specific haunt-like experiences i.e., the door creaking, unusual smells, unfamiliar sounds/acoustics, sensed presence etc. (French, Haque, Bunton-Stasyshyn, & David, 2009; Davies, 2007).

On the day after our paranormal study in Utrecht students had the morning and afternoon to investigate ideas through making prototypes. These tests and conceptual mock-ups helped to model experiences from the building study into objects that either simulated phenomena through light, through exploring cultural notions of superstition or objects to act as conduits to esoteric forces as proposals for new types of experiential products that connected the physical world with psychological interpretation.

After a morning of prototyping we conducted another study at nearby Arnhem Koepelgevangenis, Panopticon Prison. The recently retired building was excellent inspiration for investigating a different type of perceived haunted space. The layers of history and stories of strange experiences added a new perspective to the students approach to the project. Through another building study, students were able to compare perceptual experiences with the day before and analyze the different design languages employed in diverse places.

The spiritualist building in Utrecht was a place to host seances and friendly contact with the spirit world where as Arnhem Panopticon prison was a place where paranormal phenomena occurred as a consequence of an oppressive environment. The Panopticon as a piece of architecture further illustrated a design language that was employed to excerpt control, to dictate behavior and mentally affect its inhabitants through punishment, illustrated in figure 4.

Figure 4. Arnhem Koepelgevangenis (left) and one of the cells used in our study (right)

The building studies helped to reinforce the value in experiential research. Often design students reference knowledge through secondary sources, through experiencing real designed situations they are able to assess/analyze their own perceptions to these spaces while generating a connection to how design can facilitate and trigger perceptive experiences.

The penultimate day was the students last full day of prototyping, moving ideas forward into materials and 3D development. This allowed time to focus and refine conceptual ideas influenced by real experiences. The final day showcased prototypes in an exhibition in the afternoon (a sample of projects in figure 5 & 6 below). This provided an excellent finale to a week of intense presentation, investigation and examination. Students exploring the psychology of experience tested design concepts (established within an anomalous framework) and designed products/scenarios to better understand and interpret the paranormal. The workshop facilitated an inspiring week of investigating belief and personal experiences of parapsychology into designed scenarios whilst utilizing methods that materialized creative responses within a paranormal context.

Figure 5. Device using mealworms to spell out messages from spirits

Figure 6. Super Stitious Solutions – Products to protect against inadvertently walking under ladders, protecting mirrors from breaking and a knock on wood device to wear around the wrist.

3 Method

3.1 Participants

Design students (7 female and 6 male) from ArtEZ Institute of the Arts in Arnhem took part in the study. Ages ranged between 18 to 26 years.

3.2 Procedure and Ethical Considerations

A questionnaire booklet was distributed to the students that comprised 6 sections of questions and a plan/map of each location. Instructions at the beginning of the questionnaire booklet informed respondents that the study was concerned with exploring space and

investigating the anomalous. Instructions informed respondents that there was no time limit for completing the questionnaire.

Prior to exploration of each site, respondents completed Section 1 current feelings and emotions (10-items), which established general levels of emotional state (e.g., indicate to what extent you have felt this way in the past week; cheerful, happy, sad etc.).

During each visit, respondents examined 8 sites and completed Section 2 of the booklet, which examined level of intensity (I) (8-items) and emotional content (E) (8-items). Students were instructed to note down the specific locations where they noticed or felt anything unusual. Participants marked these as either I or E on maps provided. A 1-10 point Likert scale allowed participants to rate their level of each construct.

Sections 3 and 4 comprised 8-items examining belief in the paranormal (MMU Sub scale Haunting) and 6-items examining emotion based reasoning. Section 5 included 10-items that asked participants about their visit whilst section 6 asked participants to provide basic demographic information (age and gender). This entire procedure was repeated for both locations: Location 1 - Harmonia Spiritualist Headquarters in Utrecht and Location 2 - Arnhem Koepelgevangenis, Panopticon Prison.

A follow up interview with each of the 8 respondents/students took place to establish the nature and perception of each location. Each interview transcript was anonymized assured and suitable pseudonyms were generated. Themes frequency and type are presented in tables 6 and 7 below.

Finally, researchers presented feedback about each visit, which was used to guide/shape the design process for students undertaking the product design workshop. The exploration process allowed students to gather experiential information with which to shape individual design projects.

Informed consent was gained prior to each visit, and this advised participants of their right to withdraw at any time during participation. The current study obtained full University ethical approval.

3.3 Measures included

Current feelings and emotions (10-items).

These items ascertain how each respondent feels emotionally. They indicate to what extent they have felt this way in the past week using a 5-point Likert scale e.g., 1. Cheerful

1	2	3	4	5
Very Slightly	A Little	Moderately	Quite a bit	Extremely

Level of intensity (I) (8-items) and emotional content (E) (8-items) using a 10-point Likert scale. For Intensity, the scale measures between low (1) and high (10). For emotions, the scale measured between negative (1) to positive (10). Respondents mark either an (I) or (E) at each of the eight locations where they feel intensity and emotion.

A sub scale of the MMU PBS (Haunting) 8-items (PhD thesis - Drinkwater, 2017). This sub scale measures belief in hauntings. The subscale derives from a full scale MMUpbs (a new measure of paranormal belief 50-items – Drinkwater, 2017), which has been developed from an amalgamation of new items/questions, and those items loosely based on the existing items from within the (MMUSPB) (Foster, 2001).

Items were presented as statements (e.g., “Spirits of the dead can be seen by the living.” and “poltergeists exist”), which are measured on a seven point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree).

Emotion Based Reasoning, EBR (6-items). These are taken from the Cognitive Biases Questionnaire (CBQ) 30-item (Peters et al., 2010). The CBQ is a self-report measure of reasoning biases known to be associated with the formation of psychotic delusions. Each response is rated on a 3-point scale (1 = absence of bias; 2 = presence of bias with some qualification; and 3 = presence of bias). The EBR in this context assesses the cognitive process by which a person concludes that emotional reaction verifies that something is correct. Scores on each subscale are computed as the sum of ratings provided.

Visit appraisal containing 10-items. These included ‘Based on this visit do you believe that the building is haunted?’ YES/ NO or, ‘Did you have a paranormal/ghost-related experience this evening?’ YES/ NO

4 Results and Analysis

Looking at the results in the tables below it is possible to examine how students felt in different scenarios. There were significant positive correlations found across location types (see table 2), sense of experience (table 4), while haunt like perception revealed significant differences between locations at all sites (see table 5). Perceived intensity revealed no significant correlations (see table 3).

4.1 Descriptive Statistics

Descriptive statistics are presented for the current study and are given in table 1 along with the crombach alpha coefficient values both versions of the Haunting subscale of the MMUPbs (L1 Harmonia; L1 Panopticon). Cronbach’s alpha (α) assessed the internal reliability of the subscale measures (facets). All facets of the MMUpbs proved psychometrically acceptable: L1TOTALHauntings (α = .96) and L2TOTALHaunting (α = .95).

Measures include FE (Feeling & Emotion), Intensity (I), Experience (E), and Emotional Thinking (ET) which assess two locations: Harmonia (Spiritualist Church) and the Panopticon Prison.

Table 1. Descriptive Statistics for Location Totals

n=8	M	SD	Range	Min	Max	a
L1FETotal	26.75	2.25	7	23	30	
L2FETotal	23.75	2.82	8	20	28	
L1ITotal	30.25	9.19	27	16	43	
L2ITotal	32.88	8.56	20	24	44	
L1ETotal	34.63	7.93	27	21	48	
L2ETotal	32.38	6.39	18	24	42	
L1TotalHaunt	28.50	11.49	34	8	42	.96
L2TotalHaunt	25.25	10.53	34	8	42	.95
L1ETTotal	13.00	1.07	3	11	14	
L2ETTotal	12.63	0.92	3	11	14	

(Key: L1 = Harmonia, L2 = Panopticon, FE = Feeling and Emotion Total, I = Intensity Total, E = Experience Total, Haunt = Haunting Belief Total, ET = Emotional Thinking Total)

Results revealed mean and standard deviation scores across both location L1 (Harmonia) and L2 (Panopticon): (Feelings and emotions prior to the tour. L1FEtotal M = 26.75, SD = 2.25; L2FEtotal M = 23.75, SD = 2.82. Intensity level: L1Itotal M = 30.25, SD = 9.19; L2Itotal

M = 32.88, *SD* = 8.56. Perceived level of any experience (L1Etotal, *M* = 34.63, *SD* = 7.93; L2Etotal, *M* = 32.38, *SD* = 6.39. Belief in haunting, L1TOTALhaunt, *M* = 28.50, *SD* = 11.49; L2TOTALhaunt, *M* = 25.25, *SD* = 10.53, and emotional thinking, L1Etotal, M = 13.00, AD = 1.07; L2Etotal, *M* = 12.63, *SD* = 0.92) across both locations for each participant. Total scores for both location 1 and location 2 are presented in Table 1 above.

A series of paired sample correlations allowed further examination of location totals. Comparison across locations revealed the following results: Feelings and emotions prior to the tour (L1FEtotal; L2FEtotal) revealed a non-significant relationship (.729). Intensity level (L1Itotal; L2Itotal) during both visits revealed a non-significant relationship (.502). Perceived level of any experience (L1Etotal; L2Etotal) revealed a non-significant relationship (.117). Whilst, belief in haunting (L1TOTALhaunt; L2TOTALhaunt) (.004) and emotional thinking (L1ETtotal; L2ETtotal) both produced significant outcomes (.004). Mean scores comparing both L1 and L2 are presented in Table 2 below.

Table 2. Paired sample correlations for totals across both L1 and L2

n=8	Correlation	p
L1TOTALHaunt & L2TOTALHaunt	0.884	.004*
L1ITotal & L2ITotal	0.28	.502
L1FETotal & L2FETotal	-0.146	.729
L1ETotal & L2ETotal	0.598	.117
L1ETTotal & L2TTotal	0.875	.004*

** p < .05*
(Key: L1 = Harmonia, L2 = Panopticon, FE = Feeling and Emotion Total, I = Intensity Total, E = Experience Total, Haunt = Haunting Belief Total, ET = Emotional Thinking Total)

Looking at the reported total experiences across both locations (L1 & L2) respondents reported a significant difference between belief in hauntings and emotional thinking (See table 2).

Table 3. Level of Intensity

n=8	M	SD	Correlation	p
L1IO1	2.50	1.07	-0.285	0.494
L2IQ1	5.25	2.82		
L1IQ2	4.50	2.56	0.376	0.359
L2IQ2	3.63	2.45		
L1IQ3	3.63	2.07	0.389	0.341
L2IQ3	4.64	2.83		
L1IQ4	2.75	1.16	0.023	0.958
L2IQ4	5.13	1.36		
L1IQ5	2.88	1.96	0.168	0.691
L2IQ5	3.50	2.39		
L1IQ6	2.88	1.36	-0.479	0.229
L2IQ6	3.88	1.13		
L1IQ7	5.63	2.20	0.012	0.977
L2IQ7	3.50	2.67		
L1IQ8	5.50	1.77	-0.027	0.95
L2IQ8	3.38	1.51		

** p < .05*
(Key: L1 = Harmonia, L2 Panopticon, I = perceived intensity at 8 sites within each location)

Location comparisons (across level of perceived intensity) revealed no significant results. (See table 3 above). Looking at the reported frequency of intensity, the majority of

respondents indicating that level of intensity did not differ between locations for all eight sites within both L1 and L2. (See table 3 above).

Table 4. Level of Experience

n=8	M	SD	Correlation	p
L1EQ1	2.13	2.47487	0.927	.001*
L2EQ1	3.63	2.32609		
L1EQ2	4.88	0.99103	-0.165	.70
L2EQ2	3.50	1.30931		
L1EQ3	5.63	1.30247	0.467	0.24
L2EQ3	3.25	2.05287		
L1EQ4	4.63	1.40789	0.31	0.46
L2EQ4	4.00	1.30931		
L1EQ5	4.63	1.50594	0.409	0.31
L2EQ5	4.88	2.6959		
L1EQ6	4.25	2.12132	-0.47	0.24
L2EQ6	4.38	1.68502		
L1EQ7	4.63	2.26385	0.204	0.63
L2EQ7	4.75	2.86606		
L1EQ8	3.88	2.41646	-0.652	0.08
L2EQ8	4.00	2.26779		

**p < .05*
(Key: L1 = Harmonia, L2 = Panopticon, E = Perceived experience at 8 sites across both locations)

Location comparisons (across level of perceived experience) revealed a significant difference across locations L1EQ1 and L2EQ1 (p = .001). All other comparisons between location 1 sites and location 2 sites revealed no significant differences (See Table 4 above).

Table 5. Location comparison for belief in haunting

n=8	M	SD	Correlation	p
L1HauntQ1	3.875	1.64208	0.826	.011*
L2HauntQ1	3.375	1.40789		
L1HauntQ2	3.50	1.69031	0.909	.002**
L2HauntQ2	3.25	1.48805		
L1HauntQ3	3.88	1.45774	0.952	.001**
L2HauntQ3	3.63	1.50594		
L1HauntQ4	3.88	1.80772	0.812	.014*
L2HauntQ4	3.25	1.58114		
L1HauntQ5	3.88	1.80772	0.776	.024*
L2HauntQ5	3.13	1.64208		
L1HauntQ6	4.00	1.60357	0.901	.002**
L2HauntQ6	3.75	1.58114		
L1HauntQ7	2.88	1.3562	0.883	.004**
L2HauntQ7	2.63	1.50594		
L1HauntQ8	2.63	1.59799	0.766	.027*
L2HauntQ8	2.25	1.48805		

**p < .05, **p < .01*
(Key: L1 = Harmonia, L2 = Panopticon, Haunt = Belief in Haunting for both locations)

Comparisons reveal significant differences for each of the eight sites across both location L1 and L2. (See Table 5 above). The majority of respondents reported that Harmonia (L1) is perceived as being more haunted than the Panopticon Prison (L2).

This relate to the actual students who explored both locations and their experiences in each location. This is meaningful as it forms part of their experiential research. The short measure for belief in Haunting between both locations revealed a significant difference, whilst they are

simple t-tests comparing only mean scores, the score for the L1 = Harmonia vs. L2 = Panopticon (see table 5.) showed increased levels in belief in haunting. This is useful as it quantifies the environmental differences in differing conditions between the two locations.

In order to examine further the possible relationship between both descriptive statistics/results and participant experiences, an itemized table of themes (categories) revealed thematic categories that suggest an important relationship between personal experience, perception of site location and location dynamics. (See table 6 and 7 below).

Table 6. Themes and Frequency – Harmonia

Belief types and Frequency – **Harmonia**	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7	Theme 8	
Respondent Pseudonym	Seance	Haunted / Ghosts	Sense of Presence	Conditions / Feelings	Heard Stories	Environ mental Factors	Para-normal Clichés	Sense of Reality	Total Frequency
1. Tracey	1	3		5	1	2	2		14
2. Michelle		1		4	1		11		17
3. Cath		1		1		3	3		8
4. Sophie	2			2		1	2		7
5. Mark				2		4	2		8
6. Robert				2		2	5		9
7. Mary	1	1	2	3	2	3	4	1	17
8. Abigail	2			7	1	5	2		17

Table 7. Themes and Frequency – Panopticon

Belief types and Frequency – **Panopticon**	Theme 1	Theme 2	Theme 3	Theme 4	Theme 5	Theme 6	Theme 7	Theme 8	
Respondent Pseudonym	Seance	Haunted / Ghosts	Sense of Presence	Conditions / Feelings	Heard Stories	Environ mental Factors	Para-normal Clichés	Sense of Reality	Total Frequency
1. Tracey			1	1	1	1	1	1	6
2. Michelle				2	2	1	4		9
3. Cath				2	2	6	2		12
4. Sophie				4	3	2	7		16
5. Mark			1			2	1		4
6. Robert			2		2		1		5
7. Mary				2		7	4	1	14
8. Abigail				6	2	1	3		12

Both tables above represent frequency of type of anomalous themes that emerged from discussing and examining transcripts for the eight respondents. Generation of themes is in line with the strategy recommended by Braun and Clarke, (2006). Each student shared his/her ideas, thoughts and feelings about both L1 (Harmonia) and L2 (Panopticon), and outlined particular facets, conditions and feelings that best designate architectural surroundings. These may relate to the paranormal and anomalous but outline the nature of each location in terms of perceived design space and architectural conditions.

Frequency of themes and responses reveals a rich data set that allows comparison with location description (see appendix 1 for map for both L1 and L2) and analysis of each room, building and its perceived environment, respectively.

5 Discussion

Previous research reveals that many people extensively believe in some form of paranormal belief (Blackmore, 1997, Drinkwater, Denovan, Dagnall, & Parker, 2017). Indeed, Gallup polls (2005) report that nearly three-quarters of American people (73%) believed in at least one or more type of paranormal occurrence (Moore, 2005). Specifically, extra-sensory perception (ESP) (41%), possession by the devil (41%) and ghosts (32%) appear to be the most prevalent. The present study therefore, examined two locations, which revealed significant differences between perceived environmental factors, building conditions and perception of haunt related beliefs (Drinkwater et al., 2017).

In accordance with research conducted by French and Wilson, (2007), percipients revealed classic paranormal clichés including; sudden changes in temperature, damp/dark environmental conditions, dizziness, historical stories and feelings that related to a sense of presence). This educates important questions about the taxonomy of what percipients believe to be the anomalous (i.e., what is, and what is not, considered to represent the paranormal) (French et al., 2009).

In this context, the current research reveals that haunt related perception is significantly higher at location L1 (Harmonia) suggesting that specific design qualities and or environmental qualities result in an increased perception of the paranormal. The current study explored this through two different locations (L1 and L2 Panopticon Prison), and revealed that respondents perception and belief is altered when conditions appear to be in keeping with their perception of the paranormal i.e., damp dark basements, old furniture, smelly rooms.

The study's findings are consistent with a general theory that the formation of beliefs especially those considered to be more anomalous are dependent upon prior experiences and conditions experienced at locations (Irwin & Watt, 2007; French & Wilson, 2007). Specifically both locations, while different in terms of their overall design shared some qualities i.e., have many shared conditions (cold, dark, damp), both made respondents feel that there was a sense of unseen presence, and generated numerous paranormal clichés such as, shadows, dark spaces, cold drafts, strange sounds etc.

Through translating the data collected its clear to see that the design of spaces alongside preconceived notions of the paranormal have an effect on how we perceive and understand experience. In exploring territory for design and the invention of innovative scenarios that effect our mental and physical connection with our surroundings, the synthesis of paranormal research and design thinking allows opportunities to investigate these subtle and

imaginative links with the environments we occupy. What spaces are designed to do and previous stories of events that have taken place all play an important part in how we perceive these environments. Examples from interviewing participants about their experiences and how this linked to their perception of paranormal spaces.

At Harmonia, a place designed to host seances:

Michelle: The big mirror and the coat hangers with small faces were quite creepy. The cellar was the most typical horror space. The furniture was old and cracking.

The type of mirror, the old technique and black spots.. the frame and really huge it's almost a doorway to something else.

Abigail: The main room felt heavy. I sometimes in general have shivers in these situations or when in a big crowd of people. Sometimes my head feels warm and heavy. It's hard to say whether the space is doing this or something else. The air was dense/ thick. Feels like a presence. Similar to a paranormal experience I've had before.

At the Panopticon, a place designed to imprison people:

Michelle: I didn't have a feeling like it was haunted but I had a strong emotional response thinking about the people and their experience and what they must have felt like. Didn't feel scared but just an impactful place to see.

Abigail: It reminded me of a trip I went on to a concentration camp in Latvia. I remembered that experience and brought that to the prison which made the experience more intense.

The sound which the architecture created was a distinct feature. It adds so much feeling that could send you crazy. I could imagine people walking in circles hearing the echoes all the time.

Limitations in the sample size also must be acknowledged. Additionally, synergy between paranormal beliefs that may incorporate alternative explanations, as well alternative paranormal topics need further careful consideration to extend future design. Particularly, superfluities will further inform understanding of current para-design constructs that appear underpinned by paranormal belief generation and maintenance (Irwin, 2009). Anomalous beliefs therefore in this context are of importance, because the level of endorsement may feature directly because of prior experience; or, are part of the fabric within an environment, which directly affects personal interpretation of space.

The authors acknowledge that the size of the effects educed here is small and careful consideration of findings is needed. The workshop was exploratory and did not seek to establish pre-determined approaches in how to design paranormal products. It was an ideation workshop that was explorative and investigative. Confirming methods and variables will be the subject of definition in future studies exploring the concept of the paranormal in the context of para-design.

6 Conclusion: Para-design as a tool to explore paranormal phenomena

As a result of the workshop week and the investigations exploring phenomena through the lens of the paranormal, scenarios were designed that used product design as an interface to explore belief in paranormal phenomena through new experiential scenarios. Students translated site-specific research into new tools to articulate para-design thinking in the

design of objects and experiences that link perceptions of the paranormal within designed artefacts.

Figure 7. Seeking advice from the Mediumship object for Dead Designers (left) and Through selecting a key that represents a 'dead designer' the user is able to select their preferred oracle and insert the key into the device that when turned presents 'words of wisdom' communicated from the designers spirit (right)

Figure 8. Mediumship Hand (left) and Shadow projections from paper forms (right)

Through analysing direct personal experiences explored through the workshop insights were drawn between people's beliefs and how this effects their interpretation of interior and architectural spaces. The process of the exploration as research inspired the generation of ideas and concepts to inform design thinking. Meaningful design was shaped around the paranormal and in reference to experiential scenarios from the study. Similar yet different

environmental conditions trigger how we perceive places based on pre-conceptions and expectations in specific contexts (see French et al., 2009).

Through the site visits it has been possible to correlate participants pre-disposition to believe in the paranormal and experience of anomalous phenomena. Quantitative and qualitative methods through the two studies have helped to measure and document these experiences and frame an analysis of spatial experience that links the psychological and the physiological interpretation of an environment, providing interesting insights for design in the understanding of psycho-geographical (Bassett, 2004) and psycho-spatial encounters (Jung, 1959).

Through interpreting this research into new designed scenarios there is potential to further develop a new design ontology that explores experiences outside of 'normal' understanding. The engineering of space through designed environments has the potential to facilitate and mediate material experiences that explore the territory of paranormal phenomena through a new field of design research that deals specifically with the design of experiential situations that relate to engaging with the anomalous through Para-design. This is consistent with contemporary work examining the anomalous (Irwin, 2009; French & Wilson, 2007) (e.g. haunted locations), which has established associations between the designed environment through staged haunted experiential scenarios and its effect on wellbeing and behaviour (Annette et al., 2016). Exploring these in the specific context of our building studies has investigated potential to give insight into the future design of spaces related to paranormal experience through the outputs of the workshop.

In translating this study it is important to bear in mind there are different ways to make sense of knowledge through different approaches, both scientific and sensitive (Eaton, 2018). The scientific generally looking for a rational explanation to phenomena to be able to explain with a degree of certainty what was the cause of the paranormal experience (French et al., 2009). And the sensitive that interpret situations through personal belief and faith in either their intuitive ability to perceive spirits, or through the sharing of stories and therefore reinforcing the knowledge of the experience as a factual account to what has been experienced (Ironside, 2016).

Through exploring 'Sensations of the Ordinary' design is used as an interface to both embed meaning in everyday things, celebrate ritualistic/ routine actions and subvert/ influence/ change the way people live through tools that augment daily processes (Fukasawa & Morrison, 2007). Design has an opportunity to tune experience through material engagement that both stimulates physiological experience as well as probing the norm through metaphysical intervention. By rethinking and re-inventing scenarios that contribute to the everyday 'spectacular vernacular' (Parsons & Charlesworth, 2017) of design, objects and environments have the ability to embed critical commentary that inspire social dreaming (Dunne & Raby, 2013). They also engineer experiences of the designed environment to explore beliefs and invent future realities that ask us to rethink from new perspectives. Specifically, inquiry of reasoning related to our ritualistic habits and behaviors while allowing percipients to take personal ownership in designing our identities.

Moreover, the phenomenological and 'scenic' translation of belief and desire through our lived experiences countenances us to explore alternative design opportunities. This in turn generates an engagement in living through alternative systems and transpose desire, to question the rationale in applying design to lived experiences.

Data collected from the location visits and materialized translations by students has enabled the investigation of behavior and belief permitting examination of relationships concerning environmental features, design and paranormal phenomena. This research project has helped to define and translate subjective and analytical data into the development of new design concepts. These identify factors that influence the perception of anomalous occurrences and outlines variations in paranormal phenomena, providing novel insights in response to the design of experiential scenarios. This exploratory design-practice based approach to the workshop has identified opportunity to inform a broad range of research applications for future research projects that explore scenarios for health and wellbeing, enriching social and cultural relationships with place, establishing new connections with environmental ecology and developing new insights for architecture, design and spatial planning.

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Predicting Brand Experience Performance Using Virtual Reality: A Pilot Study with Automobile Showrooms Featuring Biophilic & Experiential Retail Design

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This pilot research evaluates the customer experience and business implications of different automobile showroom designs using virtual reality. We are interested in the impact of biophilic and experiential design on customer perception and behaviors.

To Investigate the impact, an experiment with 18 participants was conducted, using a three-dimensional (3D) virtual reality simulation. Participants were told that they were shopping for a new car and visiting different showrooms. Two stimuli were developed: a control showroom, based on the existing design standards of a leading automaker, and an experimental showroom featuring biophilic and experiential retail design (BERD). Each was presented via a head-mounted display (HMD) and remote used to teleport around the space. Participants were exposed to each environment, one at time. Perceived restorativeness, stress, brand experience, and purchase/re-visit intention were measured in follow-up surveys after each exposure. Survey responses to each showroom design were compared.

The experiment showed that biophilic, experiential design led to significant improvements in consumer perception of the brand and experience, as well as lucrative gains in consumer behavior such as re-visit and purchase intention. The findings also revealed that restoration, a result of biophilia in humans, mediated some of the consumer outcomes.

This study contributes to a growing body of evidence regarding the effects of biophilia in retail design. It also serves as a design exemplar for using virtual reality as a tool to evaluate environments and experiences, as well as to further study biophilia.

Keywords: brand experience; virtual reality; biophilia; user experience; retail design; automotive; business

1 Background

1.1 Project origin

This research was started in order to evaluate a past design project for a leading U.S. automaker, where the brief was to transform a legacy brand for the future. After gaining an understanding of the brand's new identity, positioning, and buyers, we proposed a holistic brand experience centered around humanism, effortlessness and the idea of oasis. Our proposed brand environments featured biophilic and experiential design. Through our study,

we intended to test some of our concepts to quantify their effects and create a business case, while also exploring new design research tools and processes.

1.2 Biophilia and its implications within retail design

Joye, Wolf et al. (2010) found that greenery in outside retail environments can provide a strategic business advantage. The study suggests that biophilic store design (BSD) has higher perceived visual quality, increases desire to patronize, increases willingness to spend, and increases shopping times. They report that BSD is an intervention that reduces stress, improving the experience for both utilitarian and hedonistic shoppers.

Another study sought to recreate Joye et al.'s research, but in an interiors context. Kristjansson (2017) showed that plants improve visual quality and aesthetic elements of space, but did not necessarily affect perception of space, shopping behavior, or willingness to spend. Because this research used photos as stimuli, it may have been limited in its perceived realism. A holistic sensory experience, in the form of an HMD, may evoke more restoration effects (Sona 2017), thus better demonstrate the efficacy of biophilic design.

Terrapin Bright Green (2012) cites the research by Wolf, arguing for greenery in retail spaces. Their article also discusses the importance of daylighting in BSD. They point to a case using Walmart as the site (Romm & Browning, 1994) where daylit sections of store saw significantly higher sales, as well as research by Heschong (2003), which found that adding skylights increased gross sales by 40% in retail stores.

Rosenbaum et al. (2018) reports that green "lifestyle centers" are perceived as "restorative servicescapes," linking to attention restoration theory (ART) effects. These may have a health and well-being benefit to shoppers. ART argues that spending time in nature improves people's cognitive function. This is because natural stimuli draw "effortless," rather than directed attention, thus helping to restore depleted psychological resources (Kaplan & Kaplan, 1989).

1.3 A growing focus on experience design in the automotive realm

Automakers realize that traditional vehicle sales venues, such as dealerships and auto show exhibits, must evolve in order to evade shrinking sales (Manoukian, 2018), and to appeal to the expectations of young, educated, creative, and progressive buyers (called the "Creative Elite" social milieu) (SIGMA, 2017). Recently, brands have focused on employing experience design, which focuses on the quality of users' experiences through moments of engagement between people and brands that ignite ideas and emotions. Thus, there's been an emergence of elevated, experiential retail centers—like BMW World and Cadillac House—that associate brands with buyers' lifestyles, and provide a robust, multisensory learning opportunity, through substantive, holistic-thinking design and space programming (O'Loughlin, 2017).

2 Methods

To investigate the impact of biophilic, experiential retail design (BERD) in a showroom, a 2x2 experiment was conceived. The primary independent variable (I.V.) is showroom design: either biophilic + experiential or conventional. The effects of this I.V. are measured within subjects, as all participants experience both showroom designs.

Several "consumer outcomes" make up the dependent variables (D.V.s). There are two sets: "consumer perception" and "consumer behavior". The former measures brand experience as

well as attention, interest, desire, and memory; the latter measures purchase intention, re-visit intention (willingness to return) and search, action, and sharing.

Bridging the I.V. and D.V.s are overarching user experience processes. We're interested in the mediating effects of (cognitive) restoration and stress levels on consumer outcomes. These factors were selected due to their operational relevance with the effects of biophilia.

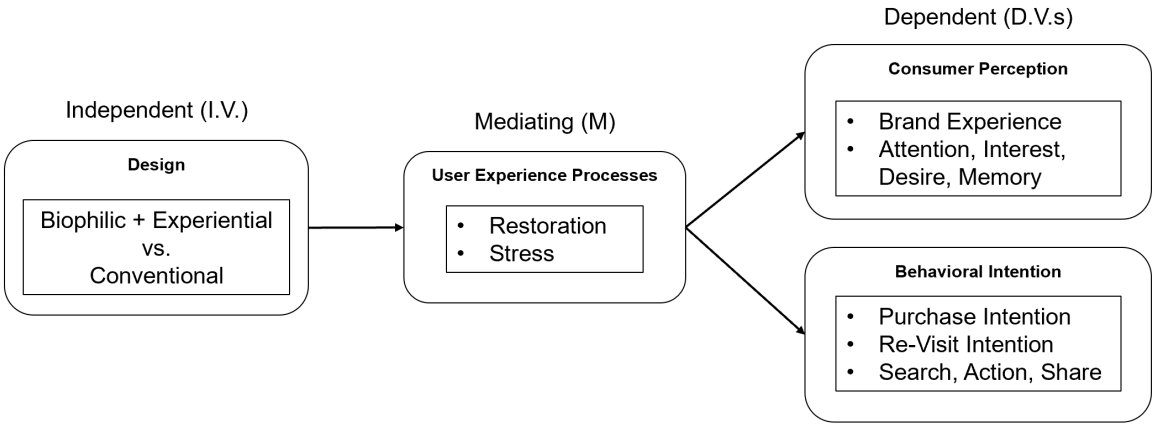

Figure 1. Map of study variables.

2.1 Participants

A total of 18 Cornell University students were recruited and voluntarily participated in the study. Recruiting was conducted through posters, social. media, and in-class promotion; participants were compensated with extra credit in participating classes.

Subjects ranged in age from 18 to 23 years (M = 19.29, SD = 1.67). All had normal or corrected-to-normal vision; they also were free of any balance/dizziness/disorientation ailments, mental conditions such as concussions or seizures, or any other impairments that would affect their safety, comfort, and performance while taking part in the study. All participants studied or had a background in creative fields. These included architecture, interior design, industrial design, fashion, landscape architecture, and UI/UX design. There were no specified quotas for different groups. The majority gender was female (15 of 18), and the majority cultural identity was Western (14 of 18).

2.2 Stimuli—Virtual Automobile Showrooms

Two virtual automotive showroom stimuli were developed using 3D modelling software (3ds Max and Sketchup), a gaming engine (Unity 2017), and virtual reality software development tools (Google Daydream). One showroom features biophilic, experiential retail design (BERD); the other, a conventional vehicle showroom design.

Despite having contrasting design philosophies, the two environments clearly read as automobile showrooms. This was accomplished through a common functional and programmatic framework. For example, both fulfilled the same basic client-facing functions, and accommodated comparable occupancy loads. An initial benchmarking process of researching automotive experience design and reviewing photos of different vehicle showrooms identified common elements and informed the framework. The environments were set in identical buildings, situated in identical cityscapes.

2.2.1 Conventional Showroom

The conventional condition represented traditional dealership environments that today's consumers would expect. The space featured an open vehicle display area; several enclosed private offices; floating office cubicles; a lounge with lounge chairs, café tables, concessions (vending machines); and a formal reception desk. The interior design and layout were heavily influenced by guidelines outlined in General Motors' Facility Image Program for the premium Buick and GMC brands. Materials included stainless steel, marble/tile, wood, and glass.

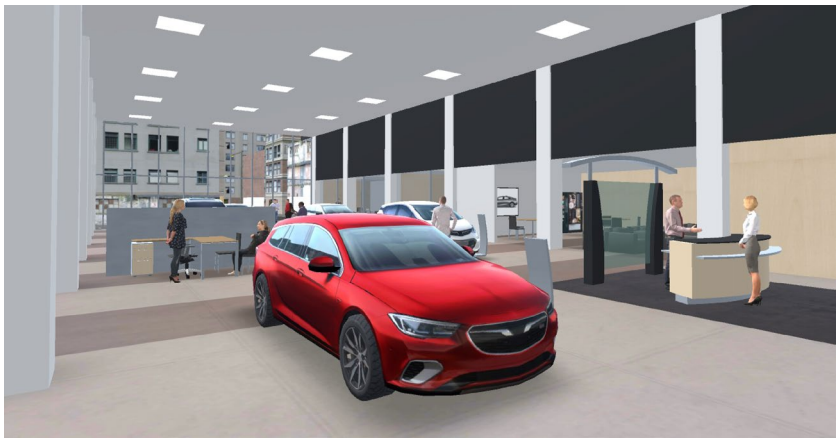

Figure 2. Conventional showroom, facing display area and reception desk, with floating cubicles in background.

Figure 3. Conventional showroom, facing display area with enclosed private offices in background.

Figure 4. Conventional showroom lounge area.

2.2.2 Biophilic + Experiential (BERD) Showroom

The biophilic, experiential showroom fulfils the same programmatic requirements, but featured a very different design philosophy. The design references General Motors' Cadillac House experience space, as well as contemporary Apple Stores and Genius Groves.

Biophilia was achieved through a range of design decisions. A row of trees was planted in the showroom, and a faux green wall was installed in the lounge space. Large light panels replaced gridded troffer lights in order to mimic the properties of sunlight. Finishes were of a similar palette to the conventional design but were adjusted to resemble nature and being outdoors. For instance, the floor was a stone-like material instead of striped linoleum.

Conventional functions and touchpoints were re-designed into innovative experiences. In lieu of closed private offices, a collaborative open workspace was provided. Client meetings were intended to be conducted at a variety of informal spots throughout the space. There was only one formal meeting space, featuring a very large digital display and a standing height conference table. The lounge space replaced individual lounge chairs for a single large, modular sofa, as well as contemporary chaise lounges. Concessions were presented in a café/buffet format, rather than through typical vending machines. Like the conventional design, tables and chairs were placed throughout. The formal reception desk was removed in favor of a "welcome space." Exposed brick and concrete created an adaptive reuse aesthetic meant to imply authenticity.

Figure 5. BERD showroom, facing display area and entry. Notice trees, light panels, and open reception.

Figure 6. BERD showroom lounge area, with formal meeting space in background. Notice faux green wall.

2.3 Setting and Apparatus

Original data was collected in the Design, User Experience & Technology (DUET) Lab at Cornell University, a well-controlled environment. Ambient noise is minimized through signage in the corridor instructing passers-by to be quiet, as well as effective noise isolation via the walls and solid door. The only lighting available is artificial ambient lighting and task lighting fixtures. Temperature and humidity are maintained at about 72 F and 40%, respectively. Testing occurred during the daytime, within typical business hours.

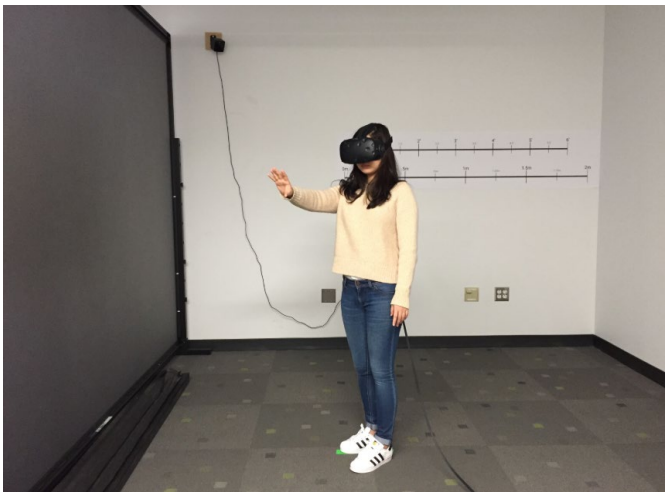

Figure 7. The DUET Lab's VR area. Source: Ethan Harris Arnowitz.

Inside the lab, a workstation was set up for collecting digital survey responses. The station was composed of a desk, task chair, desktop computer with peripherals, and task lamp. The testing area for virtual reality simulation was an open 8' x 8' space in the room, with marked targets for participants to center themselves on.

The virtual reality hardware used in this experiment included a Daydream-enabled Google Pixel 2 XL smartphone, a second-generation Google Daydream View virtual reality HMD, and Daydream wireless remote controller. Daydream is a mobile-based virtual reality system developed and marketed by Google; the combination of hardware ('the Daydream') constitutes a non-invasive HMD with touch input.

2.4 Procedure

Upon arrival, participants reviewed a consent form that outlined general information about the study, tasks, potential negative side effects, voluntary participation. They signed the document to confirm their willingness to participate and to possibly be filmed.

The setup process for the HMD included putting on the headset, adjusting the headset height and tightness through three elastic and Velcro straps, and grasping the wireless remote control. The researcher explained and demonstrated this set-up process. Once the headset was adjusted, participants were required to stand on a target on the floor, orienting them in a consistent location. Before each simulation, the researcher briefly took control of the Daydream in order to select and initiate the stimulus.

First, the participants viewed a test simulation, consisting of nondescript mountainous terrain. This allowed them to learn the Daydream's controls and become acclimated to virtual reality (to reduce novelty effects). The researcher explained navigation of the virtual environment via the headset and remote; holding up the remote also pulled up a tooltip graphic that

visually describes its functionality. When the participant was comfortable operating the system, we transitioned to the next phase.

Figure 8. Participant familiarizing himself with using the HMD and remote control.

Participants were briefed with the context that they intend to buy a vehicle and are in the process of visiting different prospective dealers. They were asked to explore each showroom and observe the vehicles during their virtual ‘visit,’ as if they were seriously shopping around.

Participants were asked to enter two virtual spaces, one after the other. One of the showrooms featured biophilic, experiential design, and the other a conventional design. Both were presented on the stereoscopic head-mounted display. The viewing order of the two showrooms was randomized to mitigate priming and carry-over threats to validity.

Participants spent three minutes each virtual environment. They had a 360° vantage point and could look around by physically turning their head and body. Participants could change their virtual location by manipulating the handheld remote, utilizing the simulation’s teleportation function.

Figure 9. Teleportation interface with remote visualization and tooltips pulled up.

Immediately after viewing one of the showrooms, the participant was asked to complete a comprehensive electronic questionnaire to understand their experience and thoughts. This process would repeat as they then viewed and evaluated the second showroom.

Upon completion of the experiment (~30 minutes), participants were provided a de-briefing to explain the study in greater detail and to accept questions and feedback. Participants were compensated through extra credit in participating courses at Cornell University.

2.5 Measures and Scales

2.5.1 User Experience Process Variables

We measured perceived restoration using the Perceived Restorativeness Scale 11 (PRS-11), developed by Pasini et al. (2014)—an evolution of the PRS originally created by Hartig et al. in 1997. PRS-11 reduces the number of questions and better understands the meaning of individual items, grouping them to create a four-factor model. Its four dimensions are fascination, being away, coherence, and scope (spaciousness).

The Zuckerman Inventory of Personal Reactions (ZIPERS) (Zuckerman, 1977) measures perceived stress—psychological pressure—using 13 items.

Together, these scales serve as indicators of biophilic design affecting the user experience through attention restoration.

2.5.2 Consumer Outcome Variables

Brand perception was measured using the Brand Experience Scale (Brakus et al., 2009). The scale's 11 items measure four brand experience dimensions: sensory, affective, behavioral, and intellectual

Purchase and re-visit intention (willingness to return) were measured via modified purchasing intent scales, as employed in Hoppe, et al. (2003). The framework understands purchase intention, and attitudes towards purchasing, as well as subjective knowledge. To measure re-visit intention specifically, the language was adapted to refer to the built environment, instead of the product, and users' willingness to re-visit.

The Attention, Interest, Desire, Memory, Search, Action, and Share (AIDMSAS) Model (Wei et al., 2013) was employed to support the findings of the purchase intention scale, and to broaden the consumer perception/behavior dimensions. The scale's 21 items measure its namesake dimensions.

3 Statistical Methods

3.1 Data Screening

Before analysis began, scales were examined using analysis software JMP for the accuracy of data entry, missing values, reverse coding, fit between distributions, and the assumptions of multivariate analysis.

3.2 Scale Refinement—Reliability and Validity

Item reliability/consistency of the scales was assessed using JMP to calculate the Cronbach's Alpha of each scale, as well as each dimensional sub-scale. Item reliability varies from a minimum of 0, to an acceptable .7, to a high of 1.0.

During refinement, if any specific item was found to significantly reduce the total item reliability, as measured by Cronbach's Alpha, it was omitted to improve construct validity.

Table 1. Scale Refinement

Variable Scale	Dimensions (# of Items)	Cases	Items Kept	Cronbach's α
User Experience Processes (M)				
Restoration PRS-11 (Pasini et al., 2014)	*Not subdivided.* Fascination (3) Being Away (3) Coherence (3) Scope (2)	18	11 of 11	.93
Stress ZIPERS (Zuckerman, 1977)	*Not subdivided.*	18	13 of 13	.83
Consumer Outcomes (D.V.s)				
Customer Perception				
Brand Experience BES (Brakus et al., 2009)	*Not subdivided.* Sensory (2) Affective (2) Behavioral (2) Intellectual (2)	18	8 of 8	.90
Attention, Interest, Desire, & Memory AIDMSAS (Wei et al., 2013)	*AIDM dimensions of AIDMSAS.* Attention (3) Interest (3) Desire (3) Memory (3)	18	12 of 12	.94
Consumer Behavior				
Purchase Intention PIS (Hoppe et al., 2003)	*Not subdivided.* Purchase Intent (3) Attitudes towards Purchase (2)	18	5 of 5	.94
Re-visit Intention RIS (Hoppe et al., 2003)	*Not subdivided.* Return Intent (3) Attitudes towards Return (2)	18	5 of 5	.93
Search, Action, & Share AIDMSAS (Wei et al., 2013)	*SAS dimensions of AIDMSAS.* Search (3) Action (3) Share (3)	18	9 of 9	.92

4 Results

4.1 Overview of Statistical Analysis for Hypotheses Tests

This study documents the evaluation (in virtual reality) of a concept automobile showroom with biophilic, experiential retail design—potentially distinctive from a conventional automobile showroom, regarding user experience processes and consumer outcomes. The former was measured by perceived restorativeness and stress; the latter were measured by consumer perception—brand experience and attention, interest, desire, & memory, and consumer behavior—purchase intent, return intent, and search, action, & share behaviors.

4.2 H1: Effect of Design on Consumer Perception

Visitors of a biophilic + experiential showroom will demonstrate more positive consumer perceptions (brand experience, attention, interest, desire, and memory), in comparison to visitors of a conventional showroom.

Table 2. Paired T-Test of Showroom Design on Consumer Perception

Variable Scale	**Conventional (n=18)**		**Biophilic + Experiential (n=18)**		
	Mean	SD	Mean	SD	P-Value *p<.05, **p<.001
Consumer Perception					
Brand Experience BES (Brakus et al., 2009)	2.75	0.82	3.54	0.75	.003*
Attention, Interest, Desire, & Memory AIDMSAS (Wei et al., 2013)	3.03	.88	3.85	0.76	<.001**

Table 3. Regression Analysis of Showroom Design on Consumer Perception

Variable Scale	B [a]	SEM	R^2	F	t (17)	P-Value *p<.05, **p<.001
Consumer Perception			.			
Brand Experience BES (Brakus et al., 2009)	0.40	0.11	0.71	2.31	3.53	.003*
Attention, Interest, Desire, & Memory AIDMSAS (Wei et al., 2013)	0.83	0.10	0.78	3.42	4.07	<.001**

[a] *Dummy coding of condition BERD with Conv. as reference*

The impact of showroom design was analyzed for all consumer perception variables. A paired t-test was used to identify significant differences; a significant p-value indicates that design had a significant impact on the scale. This was followed by multiple regression analysis to test if design significantly predicted consumer perceptions.

There was significantly greater brand experience (BES) in the BERD showroom (M = 3.54, SD = 0.75) than in the Conventional one (M = 2.75, SD = 0.82), p = .003. Regression analysis found that BERD design was significantly positively related with brand perception (B = 0.40, t (17) = 3.53), p = .003.

BERD also resulted in significantly higher attention, interest, desire, and memory (AIDM) (M = 3.85, SD = 0.76) than Conventional (M = 3.03, SD = 0.88), p < .001. Regression analysis found that BERD design was significantly positively related with AIDM (B = .83, t (17) = 4.07, p < .001).

4.3 H2: Effect of Design on Consumer Behavior

Visitors of a biophilic + experiential showroom will demonstrate more desirable consumer behaviors (purchase intention, re-visit intention, search, action, and share) in comparison to visitors of a conventional showroom.

Table 4. Paired T-Test of Showroom Design on Consumer Behavior

Variable Scale	**Conventional (n=18)**		**Biophilic + Experiential (n=18)**		
	Mean	SD	Mean	SD	P-Value *p<.05, **p<.001
Consumer Behavior					
Purchase Intention PIS (Hoppe et al., 2003)	3.20	0.82	3.83	0.86	<.001**
Re-Visit Intention RIS (Hoppe et al., 2003)	2.68	0.75	3.83	0.80	<.001**
Search, Action, & Share (SAS) AIDMSAS (Wei et al., 2013)	3.08	0.70	3.46	0.89	.08

Table 5. Regression Analysis of Showroom Design on Consumer Behavior

Variable Scale	B [a]	SEM	R^2	F	t (17)	P-Value *p<.05, **p<.001
Consumer Perception			.			
Purchase Intention PIS (Hoppe et al., 2003)	0.63	0.07	0.90	8.37	4.67	<.001**
Re-Visit Intention RIS (Hoppe et al., 2003)	1.16	0.11	0.78	3.41	5.37	<.001**
Search, Action, & Share (SAS) AIDMSAS (Wei et al., 2013)	0.39	0.07	0.72	2.45	1.88	.08

[a] *Dummy coding of condition BERD with Conv. as reference*

The impact of showroom design was analyzed for all consumer behavior variables. A paired t-test was used to identify significant differences; a significant p-value indicates that design had a significant impact on the scale. This was followed by multiple regression analysis to test if design significantly predicted consumer behavior.

The BERD showroom resulted in highly significantly greater purchase intention (M = 3.83, SD = 0.86) than Conventional (M = 3.20, SD = 0.82), p < .001. Regression analysis found that BERD design was highly significantly positively related with purchase intention (B = 0.63, t (17) = 4.67, p < .001).

The BERD showroom also resulted in highly significantly greater re-visit intention (M = 3.83, SD = 0.80) than Conventional (M = 2.68, SD = 0.75), p < .001. Regression analysis found that BERD design was highly significantly positively related with re-visit intention (B = 1.16, t (17) = 5.37, p < .001).

There was no statistically significant difference in sharing, action, and search (SAS) behavior between BERD and conventional design, p = .08. Regression analysis did not find a significant association between design and SAS behavior (B = 0.39, t (17) = 1.88, p = .08).

4.4 H3: Effect of Design on User Experience Processes

Visitors of a biophilic + experiential showroom will experience greater restoration and lower stress, in comparison to visitors of a conventional showroom.

Table 6. Paired T-Test of Showroom Design on Cognitive and Emotional Processes

Variable Scale	**Conventional (n=18)**		**Biophilic + Experiential (n=18)**		
	Mean	SD	Mean	SD	P-Value *p<.05, **p<.001
User Experience (M)					
Restoration PRS-11 (Pasini et al., 2014)	3.11	0.85	3.89	0.60	.003*
Stress ZIPERS (Zuckerman, 1977)	2.18	0.54	1.88	0.33	.02*

Table 7. Regression Analysis of Showroom Design on Cognitive and Emotional Processes

Variable Scale	B [a]	SEM	R^2	F	t (17)	P-Value *p<.05, **p<.001
User Experience (M)			.			
Restoration PRS-11 (Pasini et al., 2014)	0.78	0.11	0.69	2.07	3.53	.003*
Stress ZIPERS (Zuckerman, 1977)	-0.29	0.12	0.72	2.48	-2.52	.02*

[a] *Dummy coding of condition BERD with Conv. as reference*

The impact of showroom design was analyzed for all user experience process variables. A paired t-test was used to identify significant differences; a significant p-value indicates that design had a significant impact on the scale. This was followed by multiple regression analysis to test if design significantly predicted user experience.

Users reported significantly greater perceived restoration in the BERD showroom (*M* = 3.89, *SD* = 0.60) than in the Conventional one (*M* = 3.11, *SD* = 0.85), p = .003. Regression analysis found that BERD design was significantly positively related with perceived restoration (B = 0.78, *t* (17) = 3.53, p = .003).

The BERD showroom resulted in significantly lower stress (*M* = 1.88, *SD* = 0.33) than in the Conventional one (*M* = 2.18, *SD* = 0.54), p = .02. Regression analysis found that BERD design was significantly negatively related with stress (B = -0.29, *t* (17) = -2.52, p = .02).

4.5 H4: Mediation of Consumer Outcomes by User Experience Processes

The effects of H3 mediate the effects of H1 and H2, i.e. restoration and stress mediate consumer perception and behavior.

To determine mediation effects, multiple regression analyses were conducted to find significant relationships between the variables. After excluding non-significant results, regression was used to assess each component of the proposed mediation models. Where we could find significant associations along the a-path and b-path, mediation analyses were tested using generalized structural equation modeling in STATA software.

Table 8. Recall: Regression Analysis of Showroom Design on Process and Outcome Variables

Variable Scale	B [a]	SEM	R^2	F	t (17)	P-Value *p<.05, **p<.001
User Experience (M)			.			
Restoration PRS-11 (Pasini et al., 2014)	0.78	0.11	0.69	2.07	3.53	.003*
Stress ZIPERS (Zuckerman, 1977)	-0.29	0.12	0.72	2.48	-2.52	.02*
Consumer Outcomes (D.V.s)						
Consumer Perception						
Brand Experience BES (Brakus et al., 2009)	0.40	0.11	0.71	2.31	3.53	.003*
Attention, Interest, Desire, & Memory AIDMSAS (Wei et al., 2013)	0.83	0.10	0.78	3.42	4.07	<.001**
Consumer Behavior						
Purchase Intention PIS (Hoppe et al., 2003)	0.63	0.07	0.90	8.37	4.67	<.001**
Re-Visit Intention RIS (Hoppe et al., 2003)	1.16	0.11	0.78	3.41	5.37	<.001**

[a] *Dummy coding of condition BERD with Conv. as reference*

4.5.1 Design, Restoration, and AIDM

It was found that BERD was positively associated with AIDM (B = 0.83, p < .001). It was also found that BERD was positively associated with restoration (B = 0.78, p = .003). Lastly, results showed that the mediator, restoration, was positively associated with AIDM (B = 0.86, p < .001). Results of the mediation analysis confirmed the total mediating role of restoration in the relationship between BERD and AIDM (B = 0.67, p = .001, CI = .259 to 1.08).

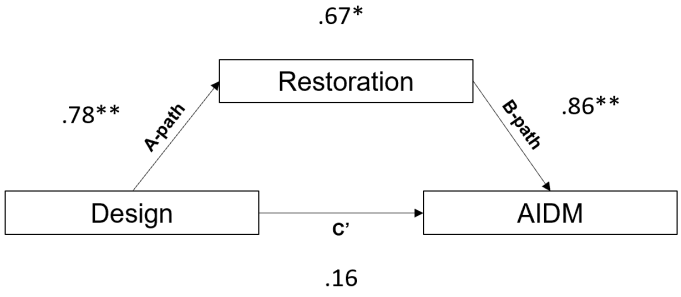

*Figure 10. Standardized regression coefficients for the relationship between design and consumer attention, interest, desire, and memory, as mediated by restoration. *p < .5, **p < .001.*

4.5.2 Design, Restoration, and Purchase Intention

It was found that BERD was positively associated with purchase intention (B = 0.90, p < .001). It was also found that BERD was positively associated with restoration (B = 0.78, p = .003). Lastly, results showed that the mediator, restoration, was positively associated with purchase intention (B = 0.55, p < .001). Results of the mediation analysis confirmed the total mediating role of restoration in the relationship between BERD and purchase intention (B = 0.43, p = .008, CI = .11 to .74).

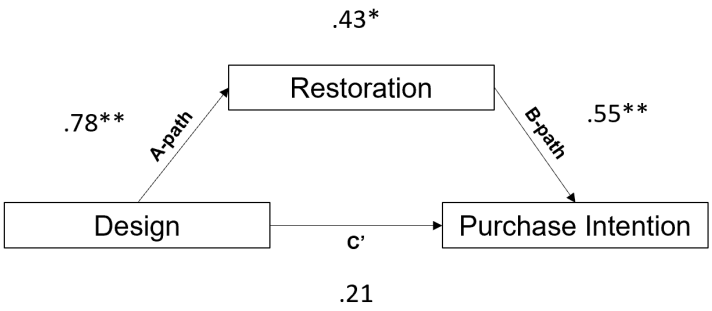

*Figure 10. Standardized regression coefficients for the relationship between design and purchase intention, as mediated by restoration. *p < .5, **p < .001.*

4.5.3 Design, Restoration, and Re-Visit Intention

It was found that BERD was positively associated with re-visit intention (B = 1.16, p < .001). It was also found that BERD was positively associated with restoration (B = 0.78, p = .003). Lastly, results showed that the mediator, restoration, was positively associated with re-visit intention (B = 0.75, p < .001). Results of the mediation analysis confirmed the partial mediating role of restoration in the relationship between BERD and re-visit intention (B = 0.58, p = .002, CI = .21 to .95).

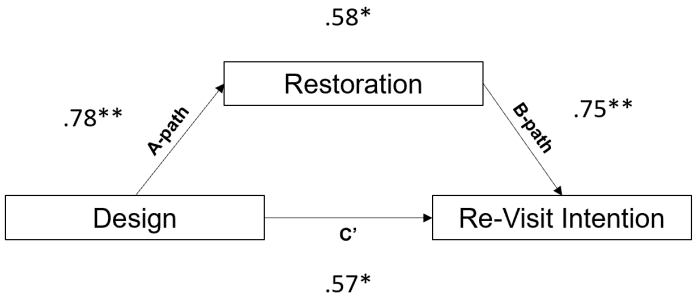

*Figure 10. Standardized regression coefficients for the relationship between design and re-visit intention, as mediated by restoration. *p < .5, **p < .001.*

5 Discussion

During the design process, we identified relevant psychographic trends and the preferences of the creative elite—young, progressive, educated customers (SIGMA, 2017). We acknowledged the rise of multi-sensory, elevated, experiential retail (O'Loughlin, 2017) and the emergence of green, "restorative servicescapes" (Rosenbaum et al, 2018). From these learnings, we created a space that essentially gives our target audience what they want, in a format that will be relevant into the future.

Our results suggest that for these clients, biophilic + experiential retail design leads people to perceive brands more favorably and to be more willing to re-visit and purchase (H1 and H2); this simultaneously validates the body of evidence above, our evidence-based design process, and the actual showroom designs.

Biophilic + experiential design in retail environments can unlock growth for businesses, especially within the domain creative elite buyers shopping for cars. It improves customers' brand experience (H1), which is a critical factor for companies in today's social and cultural context, where 89% of companies compete on customer experience (Hyken, 2018). We've

also found that consumers' purchase and re-visit intent increase with BERD (H2); when evaluating concrete products and brands, these intents would correlate with, thus predict actual sales (Morwitz et al., 2006).

Within H2, the search, action, share (SAS) variable saw no significant improvement with BERD. Participants' reluctant responses to this scale—which concerns online research, reviewing, and social media sharing--may be explained by the fact that their generation (Y and Z) is experiencing social media fatigue (Ulanoff, 2018) (Kirchoff, 2018).

The experiment also revealed an important relationship, in which the restorative and easy nature of biophilic design mediates improved consumer perception and behavior (H4). As our retail space is borderline indoor/outdoor (the building features curtain walls on three sides), our findings support Joye et al.'s (2010) conclusion that greenery/biophilic design in outdoor retail can be advantageous for business. We can also begin to generalize these effects into indoor spaces.

Kristjansson (2017) previously found no advantage of biophilic design in indoor stores. The fact that our results contradict can be explained by VR's ability to offer the holistic sensory stimulus needed to emulate the restorative effects of nature, while other mediums—like the photographs used by Kristjansson—cannot (Sona, 2017). Our finding that participants experienced significantly greater restoration and lower stress in the biophilic virtual environment may further support Sona's argument.

This research demonstrates a process for future occupancy evaluation—testing user experience and implications of designed environments and experiences *before* anything is built—using virtual reality simulation. By using VR as a research tool, designers will be able to persuasively communicate, proactively test, and rapidly iterate innovative ideas in a fashion that's both effective and economical.

5.1 Limitations and Recommendations for Future Research

In this pilot study, sample size was a major limitation. The group was small, and largely limited to Western, female, 18-22-year-old, educated creatives. Undoubtedly, they are a critical target audience, for which we offer insight. However, there is limited ability to apply our findings to a more general population. Future research should consider increasing the sample size and diversifying the participant pool to increase external validity.

Given time and capability restraints, only two stimuli conditions were developed: Conventional and BERD. By combining both biophilic and experiential design philosophies into one showroom, effects became entangled. This led to BERD clearly "winning" among consumers, but we can't dissect exactly what details (trees, furniture, materials, etc.) were the key factors in affecting consumer outcomes. A future study could separate biophilic from experiential design elements, in order really identify the effects of individual elements.

Another question is *at what point* is the design biophilic or experiential? How much vegetation do we need? Is the café serving avocado toast (as seen in the VR showroom) necessary? Finding the point at which design has a significant effect can provide guidelines for architects/designers and help maximize businesses' return on investment for BERD.

Finally, simulation realism can be improved in future studies. Reduced realism may decrease the effects and impression of stimuli on users. Due to the processing limitations of today's mobile-based VR, the geometry, texturing, and lighting quality needed to be reduced

in order to ensure smooth performance. Higher quality can be achieved with more powerful setups (e.g. HTC Vive) and future platforms.

6 Conclusion

This pilot research was conceived to validate a concept automobile showroom design. Using a virtual reality simulation, we studied the impact of biophilic, experiential retail design (BERD) on consumer perceptions and behaviors, as well as possible mediation of these by biophilia-related user experience processes. We found that BERD leads to more favorable consumer outcomes, and that biophilic effects were present and mediated these outcomes.

The findings are limited to the domain of creative elites shopping for cars, but this proof-of-concept opens new opportunities to research retail design, biophilia, and VR as a design tool.

Our study adds to a growing body of evidence that's finding compelling ways to employ biophilic design to improve and orchestrate the human experience. And, it demonstrates using VR to conduct future occupancy evaluations of concept environments and experiences; we believe this method can transform the iterative design process and proliferate design research in professional practice.

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Role of Design and Manufacturing Services in the New Product Development Process in Taiwan

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The development of the manufacturing process for innovative products has always been a challenge for startup businesses. In recent years, different types of manufacturers have emerged in Taiwan, known for its rich manufacturing resources and industry chains. In light of this, the study seeks to identify the roles played by different types of suppliers as well as the services they provide in the bootstrapping stage, seed stage, and creation stage of the startup process by conducting interviews with design consultants, design matching organizations, design manufacturing service providers, and an IoT startup. Research has found that designers can provide project management, matching, and manufacturing services as well as help startup companies visualize their concepts and evaluate the marketability of their products or services. They can also provide assistance with any communication related to prototype development and mass production, division of labor within the organization, outsourcing, and overall time management so as to make sure that the product can hit the market as scheduled. Since confirming the engineering requirements of the components of a product in the design concept paper early in the process so as to confirm the technical and manufacturing feasibility is an issue often overlooked by startup companies, we suggests startup companies seek assistance from manufacturers during the concept development stage.

Keywords: startup; innovative tech products; design prototype; product manufacturing process; Startup PLC

1. Introduction

Recent years have witnessed an entrepreneurship boom around the world. The importance of startup businesses to the domestic economy is drawing increasing attention. The Maverick Research by Gartner found that although startup companies are good at making use of low-cost products and creating IoT devices using open source hardware, they still face a number of risks including delayed or missed production date, added capital expense costs, extended project timeline, additional operating expense with no production, and risks from environmental, health and safety (https://www.mavtechglobal.com). Based on the research conducted by Shikhar Ghosh from Harvard University, 75% of the startup teams end up failing (Blank, 2013), especially when it is related to technological innovation as the highly dynamic market and technological uncertainties often lead to research and

development failures (Wang, Lin, & Hunag, 2010). Other factors include the lack of knowledge on business models and delayed technologies (Gómez, 2007). This study aims to identify ways to make use of the abundant OEM (Original Equipment Manufacturer) and manufacturing resources in Taiwan in order to provide startup teams with the assistance they need at the early stage of the new product development process, thus reducing failure rates.

2. Literature review

2.1 High tech network and policy in Taiwan

In the late 1970s, as home electronics and consumer electronics companies in the United States and Japan began to look for OEMs in Taiwan, many electronics manufacturing companies emerged in Taiwan. Subsequently, in the late 1990s, Taiwan became the world's third largest producer of IT hardware products. Some research studies believed that the success of the PC and IC industries in Taiwan should be attributed to the Industrial Technology Research Institute of Taiwan established by the government and the affiliated Electronics Research and Service Organization (Amsden & Chu, 2003). In addition to transferring the technological knowhow to local manufacturers, this phenomenon also provided the capital necessary for the diversified development of the manufacturing industry. Thanks to the government's support, many large companies met the requirements for mass production, and as a result, many local manufacturers were able to make use of new manufacturing technologies to manufacture different kinds of new products at a low cost (Saxenian, 2007).

2.2 The lifecycle of startup companies

The structure of startup companies is not only diverse but also highly complex. It was not until recent years that the explanation of the startup lifecycle came into existence. According to Salamzadeh & Kawamorita (2015), it is important that the bootstrapping stage and the seed stage be taken into consideration even before a startup company is formally established (see figure 1).

The bootstrapping stage is the earliest stage of the startup process. At this stage, a startup team is required to rely on its available resources so as to achieve its goals instead of obtaining resources from the outside. Yet, the key at this stage is for the team to determine the feasibility of the product, financial management, team structure and management as well as the strategy of the startup based on customer acceptance of the product (De Bruin, Bush, & Welter, 2006). The seed stage, in contrast, focuses on teamwork, prototype development, market entry, evaluating joint ventures, and seeking outside assistance, such as accelerators and incubators. Nonetheless, this stage is the most unstable period of time for most startup teams as many teams fail to find an appropriate support mechanism and therefore partner with companies with relatively low profit margins, further increasing their failure rate. A team begins to stabilize as it enters the creation stage, which is when the product has already hit the market and the team has begun to hire more staff, meaning that the company is formally being established.

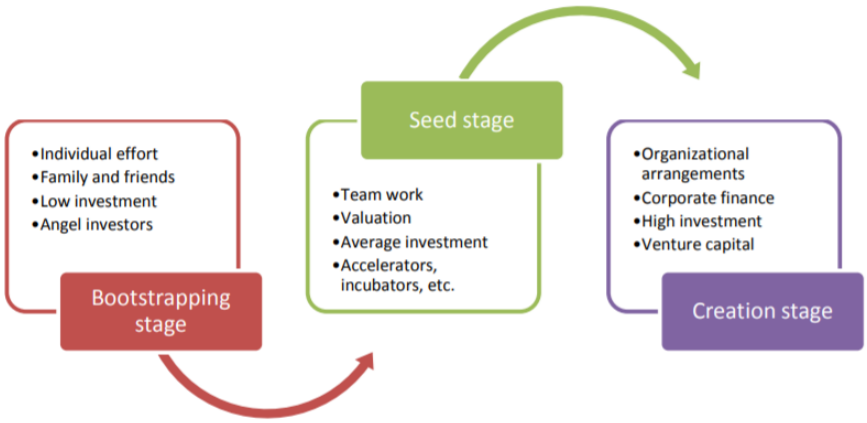

Figure 1. Lifecycle of startups (Salamzadeh & Kawamorita, 2015)

2.3 The product lifecycle of the electronics manufacturing industry

Observing the flow chart of the electronics manufacturing service, we note that whether or not the product can be delivered on time is a primary concern. The development process is usually separated into five stages. 1. Concept Prototype 2. Engineering Validation Test (EVT) 3. Design Validation Test (DVT) 4. Production Validation Test (PVT) 5. Mass Production (Folgo, 2008). This process is a widely used and studied concept in the development of electronic products and is the common way of referring to the product development process in the engineering and manufacturing industry (see Figure 2).

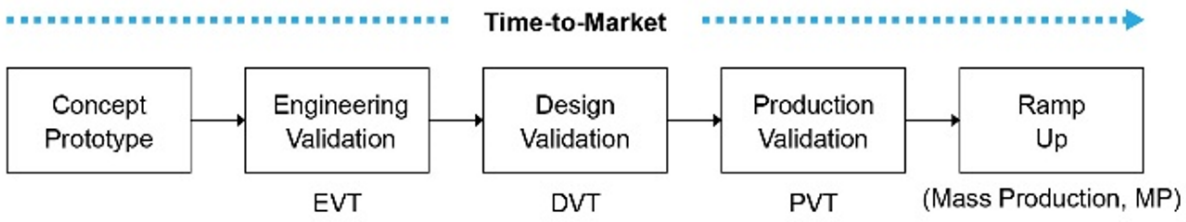

Figure 2. The product lifecycle of the electronics manufacturing industry (Folgo, 2008)

3. Research methods and subjects

This study adopted a case study method and attempted to understand the development path of each company by conducting case analysis (Yin, 2009). Prior to the interviews, the researcher first gathered online news articles of the companies being interviewed from various news outlets before designing an interview guide. Through interviewing non-profit organizations, corporate teams, and consultants that provide design and manufacturing matching services in Taiwan, the study sought to understand the challenges faced by design, technical development, hardware manufacturing, mass production, and so on in developing IoT products. In addition, the researcher conducted an in-depth interview with one of the startup companies that produce IoT products in order to understand the way the company looked for manufacturing resources. The researcher then compared the result with the research findings. The respondents are listed in Table 1. They either have experiences in developing new IoT products or have provided consulting services in this field and are

therefore very familiar with the development and manufacturing process. Of all the respondents, three of them have a design background.

Table 1 Basic information of respondents

Company Name	Taiwan Rapid Innovation Prototyping League for Entrepreneurs	Metro Products Inc.	BLOCKS (modular watch)	Director Li
Founding Year	2015	2004	2013	2016
Job Title of the Respondent	Manager	General Manager	Co-founder	Design Director
Capital	N. A.	5 million	20 million	N. A.
Location	Taipei	Taipei	United Kingdom	Taipei
Product/Service Type	Manufacturing matching /non-profit matching organization	Small-scale manufacturing company	Modular smartwatches	Product design consultant

Source: this study

4. Research findings

4.1 New product development stages vs matching services

The research findings are summarized in Table 2. The major finding reveals that three different types of service matching respondents can assist startup companies in developing and manufacturing their IoT products by playing the important roles of “project manager,” “service matcher,” and “design manufacturing service provider,” respectively. In the bootstrapping stage, for instance, a “design consultant” can help the company define problems, visualize the initial concept to facilitate internal and external communication as well as evaluate the marketability of the product (by participating in international design competitions to test the value of the concept) based on their professional design experience. In addition to identifying the human and financial resources required for the product development process and assisting with the division of labor, this individual can also attract investor eyeballs and promote the marketing concept using aesthetically appealing and succinct presentations. This study found that many designers who used to work in the technology plants have now transitioned to working as design consultants in medical technology or software startup companies. On the one hand, due to lack of resources and projects at the beginning, many startups find it difficult to afford a full-time design manager to develop their product. On the other hand, since startup companies have a relatively good understanding of the value of design, they recognize that design consultants are ideal project managers in the development process of user-friendly products as they can lead both the research and development team and help a company reach its goals in an efficient manner through visual communication. As far as designers are concerned, being the consultant of multiple companies not only allows them to focus on the key design concept of a product at an early stage but also affords them the opportunity to develop a variety of products at the same time. This type of experience is highly sought after among big brand names and large-scale manufacturing companies. Therefore, companies tend to be eager to pursue collaborations of this type.

Second, this study believed that the seed stage is the specialty for the Taiwan Rapid Innovation Prototyping League for Entrepreneurs. Taking advantage of the large amount of manufacturing information in the database of this non-profit organization will allow a

company to simultaneously identify multiple manufacturers that can offer engineering solutions as well as engineering teams. This encourages companies to focus on collaboration and to control the cost of prototype development. During the matching process, the staff from the organization will also participate in team meetings as well as meetings with manufacturers, acting as the bridge between the team and the manufacturers. The objective of the Taiwan Rapid Innovation Prototyping League for Entrepreneurs is only to facilitate the matching process and this League is not responsible for the manufacturing process and mass production. Its major asset, i.e., manufacturing resources, is not used for modifying design concepts. In light of this, this study believed that companies benefit the most from working with outside companies or teams to fulfill their needs during the bootstrapping stage and the creation stage while relying on the Taiwan Rapid Innovation Prototyping League for Entrepreneurs during the seed stage.

We believe that during the creation stage, startup companies should partner with “small-scale manufacturing companies” that have experience in mass production. The reason is that these service providers tend to be more willing to accommodate the production needs of small-scale startup businesses. Since the production scale of a startup company is especially small, it generally does not meet the minimum quantity requirements of large-scale manufacturing service providers. Furthermore, large-scale manufacturing service providers lack the incentive to confirm or modify the production process due to a product’s uncertain prospects in the market and a limited budget. Small-scale manufacturing companies, however, not only possess mass production experience in the supply chain but are also more willing to provide flexibility and co-develop the production process with startup companies, ultimately delivering the products within the agreed timeframe. Since the respondent, the person-in-charge of the small-scale manufacturing service provider, is also a designer, he/she believed that these small-scale service providers can also fulfill some of the needs of startup businesses in the bootstrapping or seed stage. That being said, this study believed that the advantage of providing manufacturing services while modifying designs is what sets these small-scale companies apart as they are more likely to be able to meet the production schedule of startup companies during the creation stage.

Table 2 Comparison Chart between New Product Development Stages and Respective Services

	Bootstrapping Stage	Seed Stage	Creation Stage
Design Consultant (Project manager managing the design)	• Identify weaknesses of the new product or service • Plan the product development path, division of labor, and communication • Visualize the concept and conduct market testing • Convert the vision into a business solution that appeals to the audience	• Assist with time management during prototype development • Look for prototype manufacturers based on personal experience • Conduct cross-discipline evaluation of a prototype to test its feasibility	• Determine the quality of the mass production manufacturer • Assist with time management during the manufacturing process
Taiwan Rapid Innovation Prototyping League for Entrepreneurs (service	• Arrange experts to conduct tutoring courses • Suggest start-up companies apply for different start-up	• Make use of the large amount of data on manufacturers held by Industrial Technology Research Institute of Taiwan	• Provide a contract for hiring manufacturers and offer partnership suggestions

matching organization managing the design)	subsidies	• Recommend experts for free consultations • Arrange and participate in meetings with the team and different manufacturers	
Metro Products Inc. (manufacturer managing the design)	• Identify weaknesses of the new product or service • Plan the product development path, division of labor, and communication • Visualize the concept and conduct market testing	• Look for prototype manufacturers based on personal experience • Assist with the manufacturing of prototypes	• Undertake trial production or mass production projects and entrust the subcontractors to manufacture the product • Deliver the mass produced products to the client as scheduled • Assist the management of inventory and shipment
The primary task in each stage	• Right idea	• Workable to prototype	• Time to market
The corresponding stage in electronics manufacturing services	• POC-EVT	• EVT-DVT	• DVT-MP

Source: this study

4.1.1 Bootstrapping stage: Identifying the weaknesses of the product concept, planning product development and division of labor, and attracting investment

All three respondents considered the development direction of a concept at the early stage to be crucial. Despite possessing specialized technologies, professional guidance on product design and sufficient planning to achieve the objectives of a design are absolutely necessary for a concept to develop into a consumer product that appeals to investors. A designer with manufacturing experience can assist in developing a project plan and identifying the weaknesses of a product concept by conducting test marketing, thus preventing resources from being wasted. This concept is consistent with the view of Fritz Frenkler (2018) from Technische Universität Münche who believed that the value that designers can offer startup companies far exceeds what they can offer medium-sized to large enterprises since the latter already have a product roadmap. Startup companies, in contrast, are relatively immature and the market for their products does not yet exist. Visual communication of their abstract and technical concepts is therefore necessary for making these companies realize the importance of design. For this reason, the study believed that design consultants can generate more value working with startup companies in the early stage of a product development project. For instance, a respondent, who is a design consultant, mentioned,

"… when observing user needs, it is important to understand that there are different types of users. Teams tend to get stuck in a rut and it's the responsibility of industrial design experts like us to put our foot down and bring the team back to reality. We have experience working with electronic products

and therefore have a good idea of the kinds of expertise and fields that are needed, the lead time, whether a concept is mature enough for product development, production issues, and mold fees."

The respondent from Metro Products Inc. also believed that without the help of a designer at the early stage of product development, innovative technology products, such as IoT devices, are likely to suffer from technological blind spots. A designer who gets involved at the early stage of a product development process can bridge the gap between technological application and user needs as well as accurately identify the weaknesses of the product design,

"… most people who develop IoT products have a background in technology. They tend to look at things from a technical perspective but not a human perspective. This is not ideal as you are not approaching things based on the basic needs of humans."

The startup team of BLOCKS, the modular smartwatch, is a case in point and can attest to the design needs that arise in the early stage of concept development including the need to detect the weaknesses of the concept, to create the prototypes needed for market testing, and the immediate need to conduct market testing. The company later drew the attention of the users through crowdfunding and grew increasingly popular among investors, which allowed them to formally establish a company. As such, the respondent said,

"… you come up with an idea. And then you need to think about demand. But how do you know what you have in mind is actually in demand? You don't know. That's why the first thing we did was to verify the demand."

The Design In Tech report published by John Maeda (https://www.slideshare.net/johnmaeda/design-in-tech-report-2017) echoed the aforementioned viewpoint. Between 2013 and 2016, there was a total of 32 mergers and acquisitions involving companies like Facebook, Google, Deloitte, Accenture, IBM, Capgemini, Wipro, and Ernst & Young. The designers at these companies did not simply contemplate and work closely with the corporate leaders or engineers to develop new products, perhaps more importantly, they listened to the needs of the stakeholders in the early stages of product development and converted visions into appealing business solutions, which helped secure funding from investors and further develop the business, ultimately fulfilling clients' and companies' development objectives.

4.2 Seed stage: Converting design concepts into engineering specifications to produce prototypes

4.2.1 Confirming the specifications and limitations of components

According to the three respondents who provide manufacturing services, the key during the product prototype stage is to lay out the concept functions in terms of "engineering specifications." Before converting an idea into engineering terms, it is vital to learn about the language used by manufacturers so as to avoid delays resulting from misunderstandings during the communication process. The respondent from Taiwan Rapid Innovation Prototyping League for Entrepreneurs stated the following.

"… you have to convert your product into simple specifications and brief them on your specifications. This is the language of manufacturing and design. Once it is done, the manufacturing company and the design company will conduct a first-stage evaluation based on that language."

The respondent from the startup company BLOCKS also mentioned that the company ran into certain issues. Due to the lack of real-life manufacturing experience, the team had to

adjust the prototype multiple times until the product was ready for production. The respondent said,

"… for this type of electronic products that are relatively complex, customizing the components would cost 20 to 30 million US dollars, which is utterly impractical. You have to know the specifications well and then look for the materials that can meet the requirements of these specifications."

4.2.2 The use of neutral industrial espionage to understand the quality of prototype manufacturers

Startup teams believed that the difficulties in producing prototypes involve not only software and hardware but also firmware, which is why it is necessary to work with multiple manufacturers. The lack of knowledge on the industry chain of prototype manufacturing and the degree to which potential partners can fulfill your needs can make it difficult for the partnership to work due to a lack of resources. For this reason, the key of this stage is to find a suitable supplier and evaluate the risks in subsequent mass production in advance. For instance, the components used in the prototype should be identical to the ones used in mass production. Moreover, it is important to purchase the best-performing components in the procurement market and avoid using non-standard specifications (even if the price is low) as those components may no longer be produced in the future, causing delays in production. Worse still, the company may have to re-modify the design. A small-scale manufacturing service provider said,

"… when it comes to hardware manufacturing, startup companies need the supply chain the help them design and manufacture their product before they can come work with us. This type of supply chains is plentiful on the streets of Xinzhuang and New Taipei City. We can deliver the products these startup companies need."

Taiwan Rapid Innovation Prototyping League for Entrepreneurs, an affiliated organization of Industrial Technology Research Institute of Taiwan, has information of many manufacturers in Taiwan. The respondent said,

"… regarding manufacturing and design, if a team feels that there's still lots of research and development work they can do themselves, I can introduce a few manufacturers to you and you can hear what they have to say. If they can help with planning and design, they will be able to tell you early on what changes you will have to make."

4.3 Creation stage: The seamless relationship between the design team and the manufacturer.

In reality, the last step of mass production depends on the correctness of the decisions made in the previous two stages. During this stage, the primary concern is the manufacturing quality in mass production and the ability to introduce the products to the market as scheduled. The respondent also mentioned that working with large-scale manufacturers might not be the ideal option for startup companies, due to the minimum quantity requirements, limited flexibility of the partnership, and the general unwillingness to fulfill the needs of a startup company. The respondent from the small-scale manufacturer mentioned,

"… our industry is about: design and one stop shop manufacturing, from planning, designing, and manufacturing a product. Clients generally hire a company to handle the entire process for them. In contrast, Foxconn, for example, will not take an order of 500, 50, or 100 units for a startup team. That's because their clients are all big corporations."

5. Research conclusion and suggestions

This research uses the “lifecycle of startups” and the “lifecycle of electronics manufacturing industry” as the framework and explores the combination of different partners that startup companies can consider when developing IoT products. This includes the following steps: 1. bootstrapping stage where startup companies can seek assistance from design consultants in order to confirm the marketability of the development concept. 2. During the seed stage, startups businesses can make use of the information of manufacturers that service matching centers are able to provide so as to increase their options for business partners. 3. During the creation stage, startup companies can look for design manufacturing service companies that are willing to take on small orders so that the products can be delivered as scheduled. In addition, we believes that the key to success that is often overlooked by startup companies is to confirm the engineering specifications of the components in the design as early as possible and to confirm the technical and manufacturing feasibility of the product. The earlier a company is able to understand the specifications and limitations of the components, the more likely that a concept will be ready for mass production and be introduced to the market on time.

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Scrum, a revolutionary approach for design research

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DESIGN RESEARCH can be characterised as being dynamic, *wicked*, and multidisciplinary. To accommodate these characteristics, design research needs to be approached differently from other types of research. Existing design research approaches identifiable in the literature are deemed insufficient to address the characteristics of design research and furthermore, the current options are limited. In this paper, we offer a new approach, adapted from a new product development framework called Scrum. It is an iterative and incremental approach, based on knowledge as it is gained. This is beneficial to address the dynamic and wicked characteristics of design research. Scrum also allows the use of multiple research techniques, which can accommodate the multidisciplinary characteristic of design research. To exemplify the application of Scrum adaptation in design research as well as to identify its pros and cons, the Scrum Design Research (SDR) approach was employed in a Collaborative Engineering Design (CED) study that aimed at developing a socio-technical architectural model. The example application shows that SDR allows the model to be created in an incremental manner. SDR also facilitates continuous lessons learned and improvement throughout the research. It encourages gathering of multiple perspectives from multiple sources and techniques to increase objectivity. The application illustrates that the approach can potentially provide a more comprehensive (from iterations) and objective (from triangulation) research result.

Keywords: design research approach, methods, engineering design

1 Introduction

The nature of design is “multi-facetted, multi-layered, and complex” (Eckert, Clarkson, and Stacey 2003, p.1). Design deals with ill-defined design problems (Bierhals et al. 2007) and consists of interrelated elements (Ouertani 2008). “There are many factors that need to be simultaneously considered to effectively manage the complexity [of design]” (Whitfield et al. 2002, p.243). Design research commonly aims to gain a better understanding on the phenomenon of design and/or improving specific elements of design (Eckert, Clarkson, and Stacey 2003) through, for example, the development of new methods and tools (Duffy and O’Donnell 1999). Due to the nature of design, design research has characteristics that differentiate it with other research areas. These characteristics are:

- Design research is dynamic (Green, Kennedy, and McGown 2002). There are uncontrollable or difficult to control factors (Sim and Duffy 2004), which can potentially force the researcher to adapt when conducting design research (Collins, Joseph, and Bielaczyc 2004).

- Design research is *wicked*. Problems in design research are often not clearly understood before working on the solution. As new findings emerge, interpretations and knowledge towards the research problem evolve (Farrell and Hooker 2013). Validity of research findings needs to be assessed following the evolved knowledge (Eckert, Clarkson, and Stacey 2003).
- Design research is multidisciplinary. To understand design, with its complex nature, requires multidisciplinary research (Eckert, Clarkson, and Stacey 2003). The use of multiple methods is often required (Green, Kennedy, and McGown 2002) to cater to the need of different disciplines.

To address the aforementioned characteristics, design research needs to be approached differently (Blessing and Chakrabarti 2009). Authors have done this by developing methodologies for design research identifiable in literature. We identified three pertinent shortcomings of these approaches. Firstly, they are created for a specific type of research. For example, Eckert, Clarkson, and Stacey's (2003) spiral of applied research was developed for group research projects that involve multidisciplinary parties, and Bracewell et al.'s (2001) methodology was created for computational design tool research. Secondly, many design methodologies are inflexible, for example, the Design Research Approach created by Duffy and O'Donnel (1999), which breaks down design research into rigid, linear steps. Finally, they can be restrictive. An example is the Design Research Methodology developed by Blessing and Chakrabarti (2009). This methodology emphasises the importance of defining clear success criteria as a parameter throughout the four-stage methodology. Although we agree that this is important, fixed success criteria can create barriers for exploration - a concern echoed by Eckert, Clarkson and Stacey (2003). Additionally, the options of design research approach are limited. Consequently, researchers adapt approaches from other fields (Eckert, Clarkson, and Stacey 2003) such as social science.

In this paper, we present an alternative approach towards design research that addresses the characteristics of design research and the three shortcomings of existing approaches we identified from literature. Our approach was adapted from a framework that was originally created for software development, called Scrum. Due to its agility, Scrum has been used in many product development processes as well as in different areas, such as research project management (see Hicks and Foster 2010, Ota 2010). We have explored the potential adaptation of Scrum in design research and applied it in our research project. How the framework was adapted, and its pros and cons based on our application are discussed and presented in this paper.

The remainder of the paper is organised as follows: Section 2 explains the adaptation of the Scrum framework to the SDR approach, Section 3 provides an example of the SDR approach being applied and its pros and cons being discussed, and Section 4 concludes the paper with a summary of work.

2 Scrum approach

The Scrum framework (hereafter referred to as Scrum) applies an iterative, incremental approach based on the belief that "knowledge comes from experience and making decisions based on what is known" (Schwaber and Sutherland, 2017, p.4). The framework is built upon three principles: 1) transparency, i.e. ensuring visibility of all aspects of the process, 2)

inspection, i.e. frequently scrutinising the process and progress, and 3) adaptation, i.e. adjusting the process based on the inspection results (Schwaber and Sutherland 2017). Because of these three principles, Scrum is deemed agile and flexible (Permana 2015). We believe that the agility and flexibility characteristic of Scrum could accommodate the dynamic and wicked nature of design research.

Scrum accepts the use of processes with various techniques (Ota 2010; Schwaber and Sutherland 2017). This addresses the multidisciplinary nature of design research. The use of various processes and techniques in research is one of four types of triangulation, along with data sources, investigators, and theories (Stake 1995). Triangulation is essential in research as it addresses potential misinterpretation and bias (Blessing and Chakrabarti 2009).

Scrum in a product development process starts with defining a set of requirements that will be used as the foundation to develop the product. This set of requirements, called the "product backlog", are defined based upon the initial knowledge and understanding the development team has of the problem. In research, aim and objectives are equivalent to product backlog as they are commonly used as the basis to conduct research and defined based on the identified research problem. As such, we used aim and objectives as the starting point of our SDR approach.

The core product development process starts after the product backlog is created. The process is called "sprint" in Scrum. *Sprint* consists of different stages depending on the decisions of the design team, e.g. design – build – test. At the end of each *sprint*, inspection is conducted. The decision to start another sprint (adaptation) or to terminate and deliver the end-product is taken based on the result of inspection. Through inspection, Scrum maximises the opportunity for feedback and adapts the next process based upon said feedback. Figure 1 depicts the Scrum framework for a general product development process.

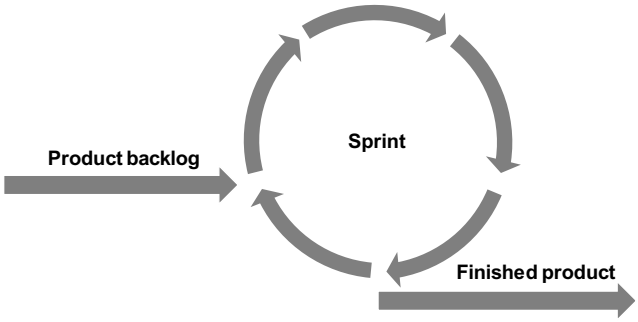

Figure 1 Scrum framework

Similar with *sprint*, the core research process can vary greatly. However, in principle, the basic research process consists of selecting methods and resources, collecting data, interpreting and analysing data, and developing a solution to the defined research problem. We used this basic research process as the *sprint* process in Scrum to create the SDR. We further added "reflection" to assess the research methods and the solution based on the incremental knowledge and lessons learned. Similar to Scrum, we used the result of reflection to decide if a new cycle of the design research process needs to be done or if the process should be terminated and the solution delivered. The steps of the SDR approach are explained in the following paragraphs.

The aim and objectives underpin any decision taken during research as research itself is conducted to achieve them. More specifically, the aim and objectives act as the basis when selecting methods and sources (Easterby-Smith, Thorpe, and Jackson 2012), and thus, need to be determined prior to conducting the research process. Since design research commonly serves two purposes: to gain a better understanding on design phenomenon and to improve design practice (Blessing and Chakrabarti 2009; Duffy and O'Donnell 1999; Eckert, Clarkson, and Stacey 2003), the formulation of the aim and objectives of design research needs to be based on the literature, through literature review, and on the design practice, through, for example, industrial investigation. From literature, knowledge gaps can be derived, while from design practice, areas for improvement can be identified. The identified knowledge gaps and areas for improvement can then be used to determine the research focus, which underpins the aims and objectives of the research.

In addition to research aim and objectives, the selection of methods and sources for data collection and interpretation needs to consider practicality factors such as time and resource availability (Saunders, Lewis, and Thornhill 2007). For a project that has a one-year time limitation, for instance, time-consuming methods such as in-depth interview and thematic analysis may not be selected. The selection of methods is also dependent on the researcher's philosophical assumptions (Creswell 2013). For example, if a researcher's philosophical assumption is *positivism,* which believes that there is a fixed, universal, single truth of reality (Rubin and Rubin 2012) that is divisible and fragment-able, and therefore measurable (Lincoln and Guba 1985; Anderson and Ozanne 1988), the researcher will typically select methods that facilitate empirical tests and follow a scientific procedure (Anderson and Ozanne 1988), e.g. experiments.

Once the methods and sources for data collection and interpretation are selected, the process to gather the information needed to achieve the aim and objectives of the study starts. As an example, a semi-structured interview is selected as a method for data collection. To collect information through a semi-structured interview, a researcher is required to prepare a set of questions for guiding the interview, allowing the questions to evolve based on the response of the participants (Kvale 2007). The data collected is then interpreted and analysed using a selected method. For example, the data collected through interview can be interpreted and analysed using thematic analysis.

The results of the data interpretation and analysis are used as the basis to generate a solution to achieve the research aim and objectives. The solution generated is then assessed against the aim and objectives of the study through reflection. During this process, lessons are learned that lead to a decision to either create an adapted plan for the next iteration of the research process, or to terminate the process. This decision also depends on research constraints, for example, time and resource availability. In other words, the number of iterations of each research process depends on the aim, objectives, and constraints of the research.

Figure 2 shows the SDR approach that was adapted from the Scrum framework.

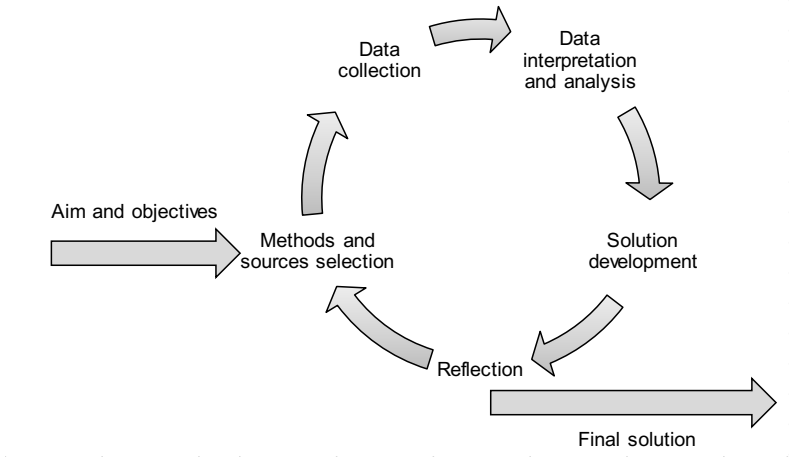

Figure 2 Scrum design research approach

3 A case example: understanding collaborative engineering design phenomena from socio-technical perspectives

To explore the application of the SDR approach, we used it in our study that aimed to better understand collaborative engineering design phenomena from a holistic socio-technical perspective. The objectives of the study were as follows:

O1. Identify issues of collaborative engineering design literature and design practice to form the basis for defining the focus of the study.
O2. Identify social and technical elements of CED and their inter-relationships to gain a better understanding of the socio-technical phenomena of CED.

The study to better understand the nature of a phenomenon that has been lacking or not properly understood may be categorised as an *exploratory study* (Saunders et al. 2007, p.133). Creswell (2013, p.47) states that a qualitative study is needed when “a problem or issue needs to be explored…”. Thus, exploratory studies are often approached qualitatively, as they both seek to explore and understand a phenomenon.

The philosophical assumption that underpins the study was *interpretivism*, which has the following basic beliefs: 1) reality can be accessed through the interpretation of individuals (Creswell 2014; Easterby-Smith, Thorpe, and Jackson 2012), and 2) there are multiple perceptions of reality (Easterby-Smith, Thorpe, and Jackson 2012). As reality is perceived to exist in human beings’ interpretation, human beings may be considered the main source of information to collect knowledge about reality. Furthermore, within the *interpretivism* philosophical assumption, the researcher (i.e. a human being) is seen as the main instrument to collect and interpret information. Lincoln and Guba (1985) argued that human beings tend to favour methods of data collection that extend their natural activity, e.g. speaking, listening, and observing, which are the main methods identified in qualitative study. Based on these points, we selected the following from within the qualitative study field: interviews and focus groups for data collection, and coding for interpretation.

To assess whether we had achieved the aim and objectives of the study, we used a *theoretical saturation point*, i.e. the point where the theory can be considered well established (Bowen 2008). The saturation point can be used as an end-point to explore a phenomenon of something (Kvale 2007). One of the parameters to measure whether the

saturation point has been reached is when new knowledge is considered seldom or no longer identifiable (Kvale 2007).

A traditional literature review was done as a starting point. The traditional literature review was selected as it could cover a wider research domain than a systematic review due to the flexibility it allows (Jesson, Matheson, and Lacey 2011). From the literature review, it was concluded that a model (hereafter referred as Socio Technical Architectural Model - STAM) needed to be developed to achieve the aim of the study. This model is what we referred to as a "solution" in our study. The first version of the model was generated from the literature review. During the SDR reflection process of the literature review, it was learned that the motivation of the study came from knowledge gaps in the literature and challenges in a CED practice. Because of this, it was deemed important to develop the model based on the literature and CED practice. Thus, the research process was continued to the second iteration, involving CED practitioners (hereafter referred as "IP-1").

In the second iteration, a semi-structured interview was selected as the method for collecting information from CED practitioners. It was considered appropriate since it allowed in-depth conversations towards a topic and could delve into individual interpretations of CED practice as required. The interviewees were chosen mainly based on practicality, i.e. CED practitioners who work in the company that funded the study. An inductive approach through coding was chosen to interpret and analyse information elicited from the interviewees as the aim of the study was to understand a phenomenon that was lacking. In an inductive approach, the data collected is interpreted with strictly-limited, or without pre-defined theories and/or assumptions (Lincoln and Guba 1985; Thomas 2006). It allows findings to emerge "…from the frequent, dominant, or significant themes inherent in raw data…" (Thomas 2006, p.238). Based on the findings identified during the interviews, the first version of the solution (i.e. the model) was significantly refined to give the second version. The main refinements included: merging the two segregated social and technical models into one socio-technical model, adding 116 elements of CED, and changing the much of the terminology used in the model. Additionally, nine socio-technical themes were identified from grouping the elements based on their commonalities.

The SDR reflection step from iteration 2 revealed three main lessons learned: 1) all interviewees were practitioners, and leaders in their team (e.g. supervisors, managers, directors). As such, the model was developed based on a single perspective (i.e. a leader of CED practitioning perspective), and 2) interview was a time-costly approach. Based on these lessons, we decided to continue the research process using a more time-effective data collection method, involving subordinate CED practitioners (hereafter referred as "IP-2") and CED academics (hereafter referred as "ED academics") to obtain multiple perspectives.

We employed the focus group method in iteration 3 to collect information from subordinate practitioners and CED academics. The focus group method involves multiple people at once and it is considered effective for obtaining insight from different points of view in a relatively short period of time (Saunders, Lewis, and Thornhill 2007). Hence, the method is considered time-effective. Furthermore "…[a] focus group allows for the proliferation of multiple meanings and perspectives, as well as interactions between and among them [the participants]" (Kamberelis and Dimitriadis 2011, p.560). Denscombe (2014) remarked that through interactions between participants, the reason underlying their response (e.g. opinion) may be understood. This cannot be obtained through individual interviews

(Denscombe 2014). We used the same interpretation and analysis approach in iteration 3 as iteration 2 as we did not find any shortcoming from its prior utilisation. The result from data interpretation and analysis was used as the basis to refine the model further. The refinements included: 38 elements deletions, 53 additions, and 46 terminology changes. In addition, the nine themes identified in iteration 2 were refined: two themes were merged into one, which reduced the total themes from nine to eight, and two theme names were changed.

One notable lesson that we learned from the reflection in iteration 3 was that the data came from people with a background in technical expertise. As the aim of the model was to understand the phenomena of CED from a socio-technical perspective, we needed to collect insights from not only those with technical expertise, but also from those with social expertise, to enhance the social perspective. For this reason, the research process was continued to the fourth iteration, involving people with social expertise and a background in CED.

To obtain a social perspective towards the model, we selected a social science academic with industrial practice expertise. This choice was based on two considerations: 1) that CED involves human beings and their interactions, which can also be found in the social science field, and 2) based on practicality reasons, i.e. such an academic exists in our university and it was challenging to find an academic with social expertise and a background in CED. A semi-structured interview method was used to elicit insight from the social science academic, due to its strengths discussed previously. The time-consuming nature of semi structured interviews experienced in iteration 2, was not deemed a problem as there was only one interviewee involved. We did not change the interpretation and analysis approach. Based on the findings, we added four new elements to the model, removed none, and did not alter any existing terminology. No new themes were identified, and no change was made to the existing themes. In other words, little new knowledge was obtained, and therefore, it was concluded that the model had reached what was recognised as the *saturation point*. However, according to Marshall et al. (2013), to confirm that no new knowledge is identifiable, research needs to be conducted past the saturation point. Furthermore, we learned in the reflection that the social perspective was still lacking, i.e. amongst the four iterations, only one iteration (iteration 4) obtained a social perspective. For these reasons, to confirm the saturation point had been reached and to further enhance the social perspective of the model, the research process was continued to a fifth iteration.

For a better insight into the social elements of collaborative work in an organisational context, we conducted a review of social literature recommended by the social science academic. Of interest from the literature were the sentences pertinent to the elements of collaborative work in an organisation that were not presented in the model and/or presented differently in the model. Based on the findings, we added 19 new elements, deleted 3 existing elements, and changed the term of one element. As with iteration 4, no new themes were identified, and no changes were made to the existing themes in iteration 5. According to Strauss and Corbin (1998), one of the parameters that can be used to determine the saturation point is when new themes can no longer be identified (or refined). Thus, although several elements changed, the lack of change to the themes was viewed as confirmation that the model had reached its saturation point. On this basis, we decided to terminate the research process and deliver the final solution.

The five-iteration research process as explained above is depicted by Figure 3.

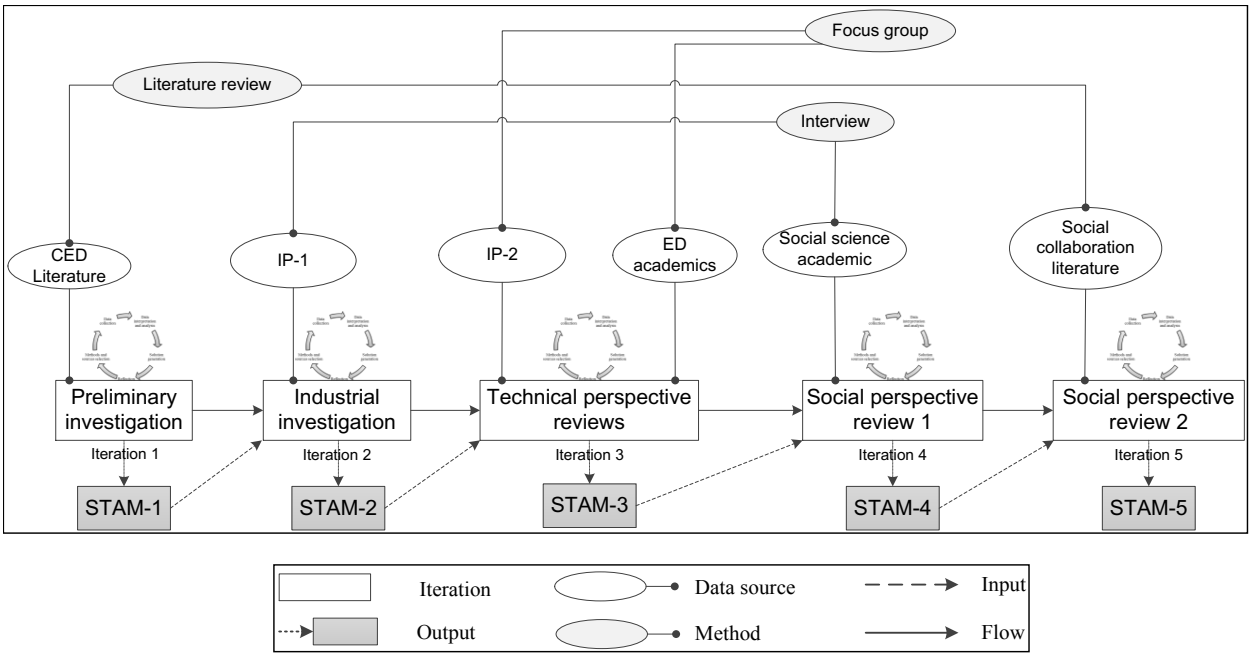

Figure 3 Five iterations of STAM development

3.1 Discussion

We applied the SDR approach in our CED study to gain a better understanding of CED phenomena from the socio-technical perspective. This was done through the development of a model that consists of socio-technical elements and their inter-relationships. Through the adaption of Scrum, the model was evolved in line with the level of understanding of the socio-technical CED phenomena. Instead of creating one final model at the end, the model was created incrementally. This was an advantage of the study, as it allowed multiple perspectives to be considered as they arose. Additionally, because of the iterative nature of the approach, issues identified from the previous iteration could be learned and mitigated. In other words, it facilitated a continuous learning process and improvement throughout the research. The lessons learned were used as the basis to plan the next iteration to increase the result's comprehensiveness and reliability. The final advantage that we identified from employing the SDR approach was that it encouraged the use of multiple data sources, methods/approaches, and/or theories (i.e. triangulation). This was useful, particularly to mitigate potential misinterpretation and bias in a qualitative study.

In addition to its advantages, we identified limitations with the SDR approach. The iterative nature of SDR brought a degree of uncertainty to the study. As the plan (e.g. methods adopted, data sources targeted) for the next iteration was determined by the lessons learned from the previous iteration, it was difficult to be fully prepared in advance. For this reason, having contingency plans was important and proved to be useful. Additionally, as Scrum could only be planned to a certain degree in the future (i.e. one to two iterations in advance) and research was typically limited by time, the plans selected for the next iteration were often driven by practicality reasons (i.e. time and data source constraints). Thus, methods that were considered to be time-consuming were often dismissed, although they might have helped to add insight towards the solution from different perspectives.

During the study, we learned that it was essential to define the termination point prior to commencing the research process. In our study, we used a theoretical saturation point, i.e.

the point where new knowledge is no longer obtained, as our termination point. We believe that this point would differ from one study to another, depending on the aim and objectives of each study. The most important thing is to define the termination point to conclude the study. Finally, SDR was tested on CED research only. However, its application was meant for all design research study. Other design research cases application would be appropriate for future work.

4 Conclusion

Design research may be characterised as being dynamic, *wicked*, and multidisciplinary. To address these characteristics, design research needs to be approached differently. Several approaches have been developed and are identifiable in the literature, such as Design Research Methodology (Blessings and Chakrabarti 2009) and Design Research Approach (O'Donnell and Duffy 1997). However, these approaches have their limitations, particularly in addressing the characteristics of design research. Furthermore, the options are limited, and thus, design researchers often use research approaches from different fields. To address these limitations, we proposed the Scrum Design Research (SDR) approach as an alternative from the existing design research approaches.

The SDR approach was adapted from the Scrum framework that was initially developed for software development. Nowadays, Scrum is broadly applied in many product development processes. Scrum facilitates continuous inspection and adaptation, allowing the product to be developed in an iterative and incremental manner, following the level of knowledge of the development team. This makes Scrum agile and flexible, which we believe addresses the characteristics of design research aforementioned.

In this paper, the SDR approach was explained and its application was exemplified in a CED study. Although the approach had its limitations (i.e. detailed plans cannot be prepared in advance), its advantages were beneficial to support our study – it allowed incremental knowledge development and facilitated triangulation. More importantly, the approach accommodated the dynamic and *wicked* nature of design research by facilitating the continuous learning process and improvement in a systematic way. The example of its application in our study illustrated that the approach also has potential in providing more comprehensive (from iterations) and objective (from triangulation) research results. SDR application in other design research study is suggested for future work.

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What Kind of Research is Research Through Design?

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This paper serves as an analysis and critique of research through design, asking whether research through design is actually different from existing methods of scientific research, which is the way it is portrayed. If it wasn´t different would this be a desirable or undesirable? Embedded in the concept of research through design is the idea that there is a "designerly way of knowing" that justified the use of the method as opposed to "standard" research methods. The paper asks if this assumption is on safe ground. The paper presents models of "standard" research in design (and examples) and research through design processes (and examples) and compares them to see what similarities and difference exist.

Keywords: research through design, research design

1 Introduction

Frayling (1995, in Grand and Jonas 2012) discusses the distinction between research into art and design, research through art and design and research for art and design. In recent years much work has been done using the RtD approach rather than pure research into design (see Gaver, 2012 for a guide). The question arises as to what precisely the distinction between "standard" research design and the novel RtD approach might amount to. This paper serves only as a start point in a critique of the RtD. This paper asks whether research through design is actually different from existing methods of scientific research, which is the way it is portrayed. If it wasn´t different would this be a desirable or undesirable? Embedded in the concept of research through design is the idea that there is a "designerly way of knowing" (Schoen, 1983) that justified the use of the method as opposed to standard research methods. The "designerly way of knowing" implies a difference in how something is known that comes from finding out about it in a certain ("designerly") way. The paper asks if this assumption is justified.

This paper was inspired by PhD courses at the Aarhus School of Architecture given in 2017 and 2018 on research design for research through design. First it was asked what research design is? "… Research design is the logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study" (Yin, 1994). The tutor (the author) presented a lecture which suggested case study research was an appropriate model for research through design, drawing upon Yin´s (1994) methodology. The students themselves had identified their work as falling into the RtD class which is why had signed up for the course. It became apparent that only half of the students would find Yin´s approach useful for their PhD research. The others had projects where it was clear other methodologies

applied for the purpose of extracting communicable knowledge from their experiments. Those methods were broadly ethnography, interviews, documentary analysis and photographic evidence. As a whole, the projects could be treated using any of the existing methods of analysing the data rather than a specifically RtD approach.

If the research procedures fell into the existing categories, on what basis was it correct to identify research through design as something distinct from research in design with which it is commonly contrasted?

2 Research

Before moving on, let us consider research in general. Research can be understood as systematic enquiry into X to discover communicable knowledge (modified from Frayling, 1993). After Archer (1995), research is systematic because it is pursued according to “some plan”; is an inquiry because it seeks to answer some question; is goal-directed because its objects of inquiry are defined by the task description; and is knowledge-directed and, finally, research must be *communicable* so the findings must be intelligible. Knowledge can be defined as justified, true belief. Of that trio, the word “justified” is the most pertinent. It means the findings must have a basis that can be objectively demonstrated. The point then of design research is to study “design” and to communicate that knowledge, to communicate the findings.

The kind of research done can be categorised. Archer (1995) breaks research down into five groups, but in practice, any research may contain elements of more than one category in that a sub-project in one category might support a bigger goal in another category.

- Fundamental research: systematic inquiry directed towards the acquisition of new knowledge, without any particular useful application in view.
- Strategic research: systematic inquiry calculated to fill gaps in fundamental research and/or to narrow gaps between fundamental research and possible useful applications.
- Applied research: systematic inquiry directed towards the acquisition, conversion, or extension of knowledge for use in particular applications.
- Action research: systematic investigation through practical action, calculated to devise or test new information, ideas, forms or procedures and to produce communicable knowledge.
- Option research: systematic inquiry directed towards the acquisition of information calculated to provide grounds for decision or action.

Turning to the nature of the output, the knowledge takes the form of theory which is useful if it has general applicability and predictive power. Typically design theories are an amalgam of descriptive, descriptive and prescriptive (Vermaas, 2010). Theories can 1) describe design practice such as structure, actions, reasoning and (2) then prescribe these for future practice. Alternatively theories in prescribing design practice are also demarcating design from non-design (the debate on science versus design is an example). Finally, prescriptive design theory becomes descriptive when a tool, for example, is adopted and described.

So, theory-building is an important aspect of any research. Out of the work comes theory which then can be used to alter courses of action in the future. But, according to Zimmerman et al (2010) theory-building is the weak aspect of research through design. Nonetheless RtD is a method that is used increasingly both inside design, architectural- and engineering-design research (ibid. p.310; Verbeke & Pak, 2013).

It is useful now to present a description of RtD. There are a number of ways to introduce research through design. It is a “research approach that employs methods and processes from design practice as a legitimate method of inquiry” and “where the knowledge gained can be implicit, residing almost entirely in within the resulting artefact” (ibid). Buchanan (1999) provides an historical context, seeing practice-based research as a way to draw into the academy the knowledge-finding approach that was once ignored as merely artisan. See Fig. 1 (below) for a schematic representation of the division in arts research.

Research through design is seen as an attempt to re-value practice. Archer (Grand and Jonas, 2012: 109-122) distinguishes first between research in the science tradition and research through practitioner action. Science research (general, universal) and practice (particular) are often seen as distinct: "We understand practice as something that belongs to and is determined by a specific context while theory is performed by moving away from a particular context in order to reflect upon it from a more neutral or objective point of view" (Friberg, 2010, p.19). RtD can be understood as a means to re-link theory and practice.

Nowotny et al (2010) propose a sociological interpretation on why design research might take a turn towards practice. They propose that there is operating what they term Second Modernity in which the “weakly contextualised, autonomous science” is supplanted (or joined by) strongly contextualised research that participates in society”. In place of reliable knowledge the aim is to create socially robust knowledge.

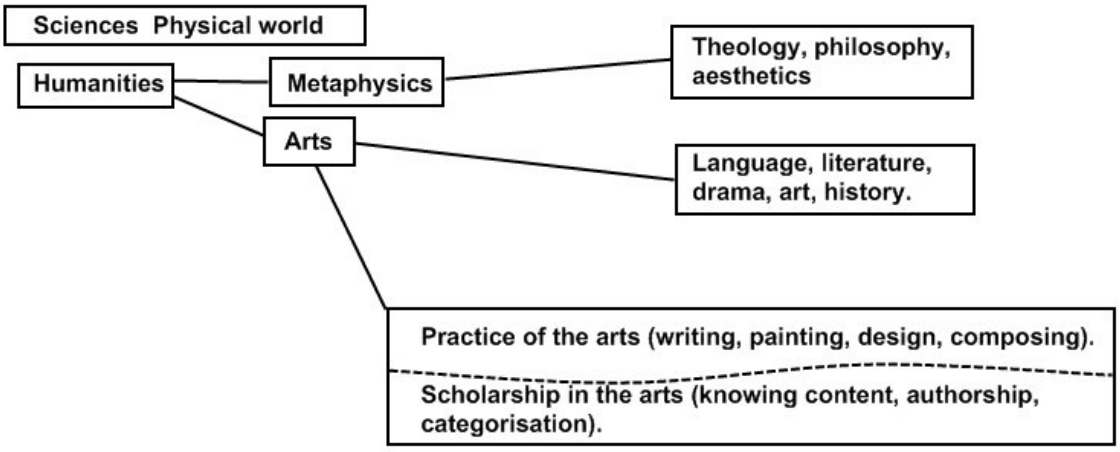

Figure 1. Arts and Sciences (based on Buchanan, 1999).

Research through design frames "the possibility of design being done on the basis of design practice i.e. by artistically/creatively making objects, interventions, processes etc. in order to gain knowledge". (Bang et al. 2012). Practice-based research strategies, as RtD may be also called, are generally concerned with advancing practice and the nature of practice, coming from Schoen´s (1983) understanding of the reflective practitioner and include the practitioner´s strategies such as reflection in action, participant research and action research

(Amacker, 2017). "RtD offers several distinct advantages (...) allows researchers to rely on designerly activities as a way of approaching messy situations with unclear or even conflicting agendas; situations that are not suited to other methods of inquiry." (Zimmerman et al. 2010, p.310.) “There are circumstances when the best or only way to shed light on a proposition, a principle or material, a process or a function is to attempt to construct something, or enact something or test it” (Archer, 1995, p.118). That formula may sound familiar.

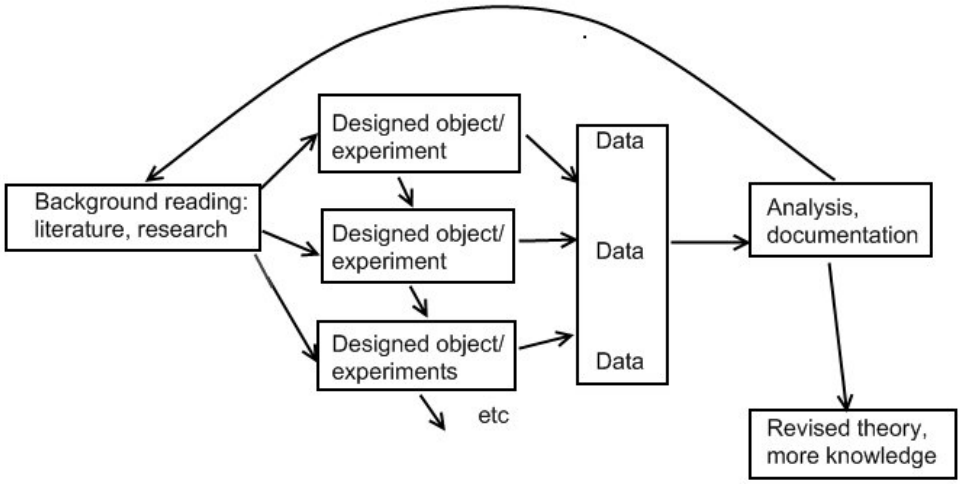

Figure 2. How research through design might work.

"Why is PBR (or RtD) not disqualified as a research model when it entails researching a process the researcher is a part of?" asks Friberg, (2010 p.20). The short answer proposed is that in other research the researcher is *also* involved: a scientist or sociologist is part of the arrangement. In RtD this involvement is, however, explicit. Friberg disputes the classical distinction of “traditional research” against which non-traditional research through design might be opposed. He argues that what is called traditional research cannot be clearly demarcated. Rather there is “a complex and extensive field of different research practices" (ibid). Further, the matter of context dependency is discussed within the natural sciences (the typical model opposed to design research) by Kuhn (1970) Feyerabend (1975) and Latour (2003). Friberg makes the point that "knowledge of laws (theories) is not merely to know formulations thereof but also to understand their practice. Each form of knowledge is performed in their specific practice." (Friberg 2010, p.28). For this to happen, one must stand outside “design” in order to attain an objective view of it. That being the case, research through design is an example of using X to study X. The designer engages in design activities and then reports on the discoveries.

3 Science and Design

In order to assess what kind of research through design is, it is helpful to recall some distinction. Cross (2001) makes these. (1) Scientific design “refers to modern industrial design … based on intuitive and non-intuitive design methods.” As Cross says, this is probably not a controversial concept. It is how design is taught in design schools and involves an understanding or where art and science meet in solving design problems. (2) Design science can be explained and dispensed with relatively easily. This emerged from a belief in the universal application of natural science approaches to create a standard design

method. Hard systems or positivist approaches (Broadbent, 2003) fall into this category. If it has any application it is in the solution of what Rittel and Webber (1973) call “tame problems” and quite possibly involves little aesthetic content. The design science approach entailed some methodological improvements such as making design more impersonal and objective. It neglected the psychosocial aspects of solving problems. What is of interest here is the (3) the science of design. Cross writes that design is the subject of scientific investigation or “research” which was described above as “as systematic enquiry into X to discover communicable knowledge”. Up until the introduction of the concept of research through design, such scientific investigation broadly used a variety of methods to observe and analyse the activities (what they did) and outputs of designers (what they made). It is what Cross calls “that body of work which to attempts to improve our understanding of design through scientific (i.e. systematic and reliable) methods of investigation” (Cross 2001, p.54). These studies fall into two classes, the quantitative and the qualitative. Examples of quantitative work might be a lab study of consumer responses (e.g. Hagtvedt and Patrick, 2014); a consumer study (e.g. Shih-Wen et al. 2008) or a study of the effects of styling and functionality (e.g. Sonderegger and Sauer, 2010). In these cases the researchers looked into consumer responses and used statistical methods to analyse the results. The type of work termed qualitative (or “semi-qualitative”) is where the design process is studied in a retrospective fashion via interviews and documentation of the design process e.g. Loureiro et al (2010) or Daly et al (2012).

Schoen (1983) criticised the positivist philosophy which supports the design science movement and Galle (2014) provides a review of further arguments for why design is not the same as science and continues the argument. Archer (1995) and Frayling (1993) explain how practitioner research was sidelined. Nowotny (2010) explained the sociological rationale for this shift in attitude to the science of design. Following this argument it is proposed that research in design can be carried out through design: design activity by the researcher is used a means to study the nature of design. That leads to a question of epistemology, how we know what we know. Schoen proposes an epistemology of practice, “based on the reflective practice of design”. What is worth focusing on is the way Schoen elides *what* can be known about design with *how* it is known. It is argued that knowledge “inherent” in artefacts is one type of design knowledge and there is knowledge “inherent in processes of manufacture” as well. Schoen writes of a “designerly way of knowing”.

In response to those arguments, one must note that knowledge exists in a mind and not in an entity (a text is a representation of knowledge). Second, though each discipline has specific technical knowledge, this is not the same as a basic epistemological difference. Does it make sense to talk of a sociological way of knowing? Perhaps Schoen means a designerly way of finding out. Third, the “epistemology of practice implicit in the artistic, intuitive processes” (Schoen, 1983) of design is a concept that runs into the problem that knowledge must be communicable to count as such. The “implicit” is precisely where the focus of design research is. The implicit must be made explicit which brings us back again to the question of how to do so.

This sections ends with the summary that even if designers have specialist knowledge they do not know things in a way that is distinct from any other rational person´s way of knowing. To the extent that designers do know things with confidence it is due to their paraphrasing of the science method of making observations and checking hypotheses.

4 Standard research-in-design process

Below is a diagram showing a simplified standard process how research in design might be conducted (Fig. 3):

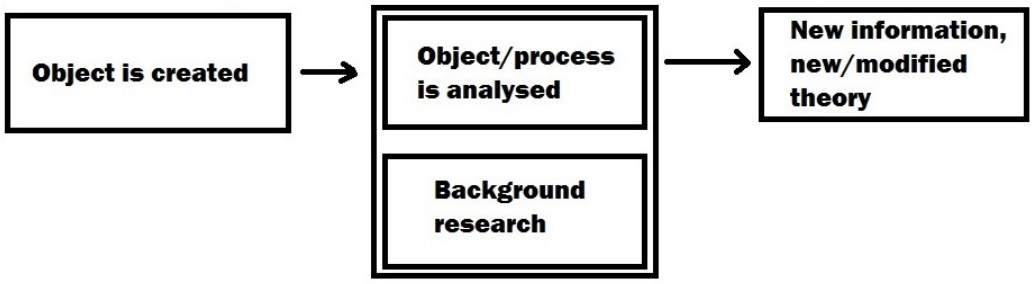

Figure 3. Simplified research into design process "A".

In this model, "A"; at some point in time an object is created, the result of a design process. The design researcher begins their research at some time after the object is made which leads to a research question. That leads them to wish to investigate an appropriate subject. From all pre-existing subjects, they select an object, a class of objects or a process (or a combination). That study, which may be quantitative and/or qualitative, leads to new information on the object and its design process. On the basis of resultant findings, theory is modified or new theory proposed.

Another version of the standard research in design process looks like this (Fig. 4)

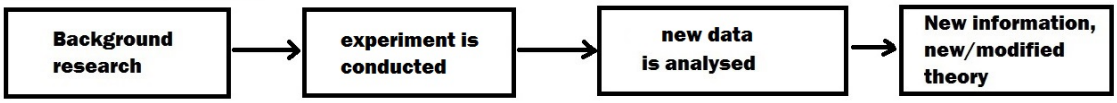

Figure 4. Simplified research into design process "B".

In this example, "B", background research is conducted that leads to a research question. An experiment is conducted which leads to the generation of data. Analysis of the results leads the relevant theory is modified or revised. The quantitative studies cited above in Section 3 would be examples of this kind of research. A hypothetical example might be work in visual cognition leading to experiments looking at user interfaces. That might involve models being made of different interfaces for, say, a coffee automat.

Now, a model for research through design. Putting it in very plain terms, research through design attempts to discover knowledge by doing design work. What would be an example of research by design? Liekens (2013) constructed architectural "machines" to allow for communal cooking; Schoffelsen et al. (2013) studied "playful design representations". Koskinen (2011, p.5) cites the example of the iFloor, "an interactive floor built between 2002 and 2004 in Aarhus, Denmark…It was a design research project with participants from architecture, design and computer science… The aim of the floor was to bring interaction back to the library" (ibid, p.1). Two PhD theses emerged from the work on the floor. "It was

this theoretical work that turned the iFloor from a design exercise into research that produced knowledge that can be applied elsewhere" (ibid. p.2). The researchers constructed an object and made new discoveries. Koskinen notes that a slide show or CAD model would not have had the same effect. So, for Koskinen, the difference between standard design research and this example is that the researchers *made an object*. There is no point where this explanation of the activity can be faulted. Generally then, research through design work as show in in Figure 5 below:

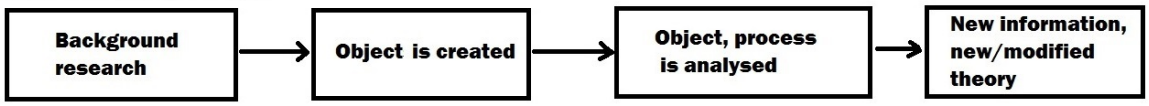

Figure 5.Simplified research through design process...

It is important to note that much useful design research (science of design) is done during each phase represented in the flow diagram in Figure 5. The background research involves defining the state of the art and formulating a research question. The designed object/s e.g. the iFloor produce/s data which is both quantitative and qualitative. This then leads to new theory or a modification of theory. The part of the research through design method that is said to be novel is the creation or design of the experimental objects. However, if we compare Figure 5 to Figure 4 they are similar. Essentially, the design part of research through design is equivalent to conducting an experiment to test a hypothesis. A criticism of this comparison is that it is based on the author´s own definitions of what research in design is and how research through design is conducted. The defence to this critique is that that there aren´t other conceivable models for conducting a systematic enquiry into X to discover communicable knowledge about it. Any variation in the structure of the diagram shown in 4 involves adding more experiments or repeating the process until a result is arrived at. The comparison of Figure 4 and 5 shows that research through design is analogous to experimental science. Design research can follow only two principle paths:

- Abstract research – reading and analysing written texts about design research etc.
- Concrete research – a) studying a pre-existing designed thing or 2) conducting an experiment.

Both research through design and research in design make objects/processes their object of study. The only difference is that in the case of research through design the object is made for the purpose. Research in design selects objects and the associated processes from ones made by someone else. After that the methods for observation and analysing them are the same: quantitative and qualitative research techniques. In another similarity, both research in design and research through design conduct experiments. A researcher in design might conduct a laboratory experiment to study the response of subjects to variables (e.g. colour preferences or ergonomic studies). A researcher through design creates an experimental object. Both are artificial situations.

It is also apparent that research through design is analogous to experimental research in natural sciences or social sciences (or is a hybrid of both). In both cases, a reading of the

background theory leads to a research question which is testable by experiment. The difference lies in the extent of and effect of the designer/researcher´s role in the design work.

5 Conclusion

This paper is focused on research methods: what you do and how you are sure of what you find. Based on the foregoing, it transpires that from a methodological point of view research through design is on precisely the same safe ground as any other form of concrete research into non-metaphysical matters. That is, so long as it conforms to the goals of being a systematic enquiry to discover communicable knowledge. As Friberg (2010) points out, it is not disqualifying that the researcher is part of the system being studied. Research through design is part of a well-established tradition in science of using an experiment of some type to test a hypothesis about X. This procedure is, after all, exactly what practicing designers do too: make some observations about the world, make a hypothesis that the user needs object X and then test the hypothesis by making a prototype of X.

It was pointed about one of this paper´s reviewers that Gaver (2011) had to some extent addressed the matter of what we should expect from RtD. Gaver concluded “that research through design is likely to produce theories that are provisional, contingent, and aspirational”. Having made the argument in the previous sections that the knowledge itself is much the same as if gained from “standard research”, the kind of theoretical output will also be much the same. And indeed, since according to standard science theory, a theory is indeed provisional anyway, Gaver´s (2012) conclusions are not decisive in determining what it is that distinguishes RtD from standard design research.

In section 1 it was asked whether research through design was unlike “normal” design research and if it wasn´t would this be a desirable or undesirable? The answer suggested here is that research through design is not unlike normal design research and that this is not an undesirable outcome.

Perhaps if there is some confusion in what research through design is, it is to mistake the design of an experimental object for a new way of doing research. But the counter-argument is that research through design might be a test of the new design process that leads to a new object. In which case the *process* is the object of study and not the resultant new product. Again, research in design has also studied design processes so process study is not unique or exclusive to research through design. Research through design is possibly about the process and the type of object produced. Again, research in design does this too: a study of Inclusive Design would be interested in the way (means, process) to achieve an Inclusively Design object (end, product).

That leaves the matter of epistemology or how you know things: the “designerly ways of knowing”. It is argued that in designing a new object to test a theory the designer can discover new knowledge through a process unique to the profession. As this paper shows there are a finite number of ways of knowing even if there is an infinite number of things to know. We are interested in the science of design and not whether designers are like scientists. In that sense, it does not matter if the researcher is a designer or not. Once the designer has created the new object (e.g. an iFloor) they still have to switch hats, so speak, and observe and report as a form of scientist. They make accurate observations, record the data, analyse it and then propose what are hopefully falsifiable claims about the world e.g. a particular way of designing will achieve particular results.

Designers have no other special access to reliable knowledge or justified, true belief. Schoen and others are not making a metaphysical claim about designers' insights. So it is perhaps at best a claim about tacit knowledge. Unless tacit knowledge is elevated to the same level as explicit or communicable knowledge, the idea that there is a designerly way of knowing is either an unsupported or a weak claim.

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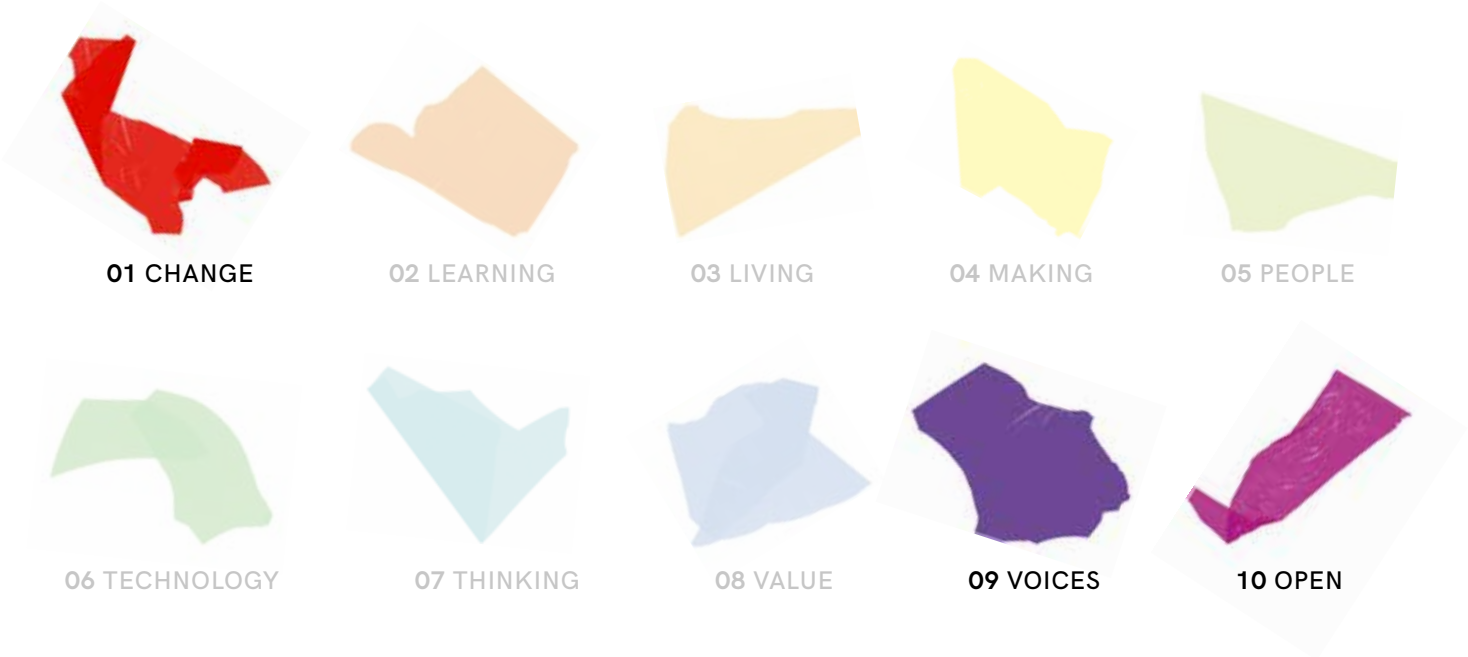

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